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DEPARTMENT OF THE ARMY FIELD MANUAL

**105-MM HOWITZER
LIGHT, M102, TOWED**



HEADQUARTERS, DEPARTMENT OF THE ARMY
APRIL 1964

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HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 7 April 1964

105-MM HOWITZER, LIGHT, M102, TOWED

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CHAPTER 1

GENERAL

1. Purpose and Scope

a. This manual is a guide to assist commanders and chiefs of sections in developing M102 towed 105-mm howitzer sections into teams that will operate effectively in battle.

b. This manual prescribes the duties of the section personnel in—

- (1) Section drill.
- (2) Preparation for firing and traveling.
- (3) Firing.
- (4) Tests and adjustments.
- (5) Maintenance and inspections.
- (6) Decontamination of equipment.
- (7) Destruction of equipment.

c. This manual is applicable to both nuclear and nonnuclear warfare without modification.

d. To improve this manual, users are encouraged to submit recommended changes and comments. The procedure is as follows:

- (1) Key comments to the specific page, paragraph, and line.
- (2) Include supporting reasons for each comment.
- (3) Send direct to U.S. Army Artillery and Missile School, ATTN: AKPSIPL, Fort Sill, Okla.

2. Composition of the Howitzer Section

a. The personnel of the howitzer section in the airborne division are the—

- (1) Chief of section (CS).
- (2) Gunner (G).
- (3) Assistant gunner (AG).
- (4) Five cannoneers, numbered 1 through 5.
- (5) Prime mover driver (D).

b. The proposed personnel of the howitzer section in the air assault division are the—

- (1) Chief of section (CS).
- (2) Gunner (G).

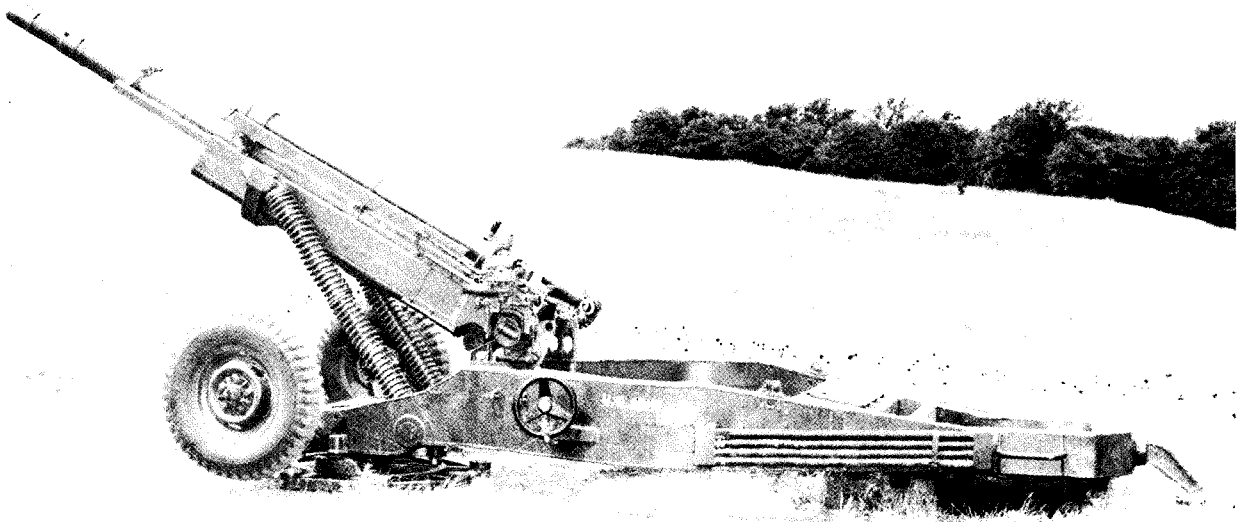


Figure 1. 105-mm howitzer light, M102, towed.

- (3) Assistant gunner (AG).
- (4) Four cannoneers, numbered 1 through 4.

Note. The personnel as indicated in *b* above are tentative. The duties as listed in the tables of this manual have been prepared for the standard towed light howitzer section as found in the airborne division. If the howitzer section in the air assault division remains as indicated above, the duties of the number 5 cannoneer will be assigned to the number 3 and 4 cannoneers as appropriate.

3. Duties of the Chief of Section

The chief of section is the noncommissioned officer in command of the section. He is responsible for the—

- a.* Training and efficiency of personnel.
- b.* Performance of duties in drill, firing, tests and adjustments, inspection, and maintenance.
- c.* Observance of safety precautions.
- d.* Preparation of field fortifications.
- e.* Camouflage discipline; local security; and chemical, biological, and radiological security discipline.
- f.* Maintenance of the equipment logbook (TM 38-750).

- g.* Police and improvement of the section area.

4. Equipment

Section equipment is shown in figure 2.

5. Definitions

a. Front.

- (1) The front, howitzer coupled, is the direction in which the prime mover is pointed.
- (2) The front, howitzer uncoupled, is the direction in which the muzzle points.
- (3) To determine the left or right of the howitzer itself, coupled or uncoupled, the front is the direction in which the muzzle points.

- b. Right (left).* The right (left) of one facing to the front.

6. References

Publications applicable to the 105-mm howitzer light, M102, towed, are listed in the appendix.

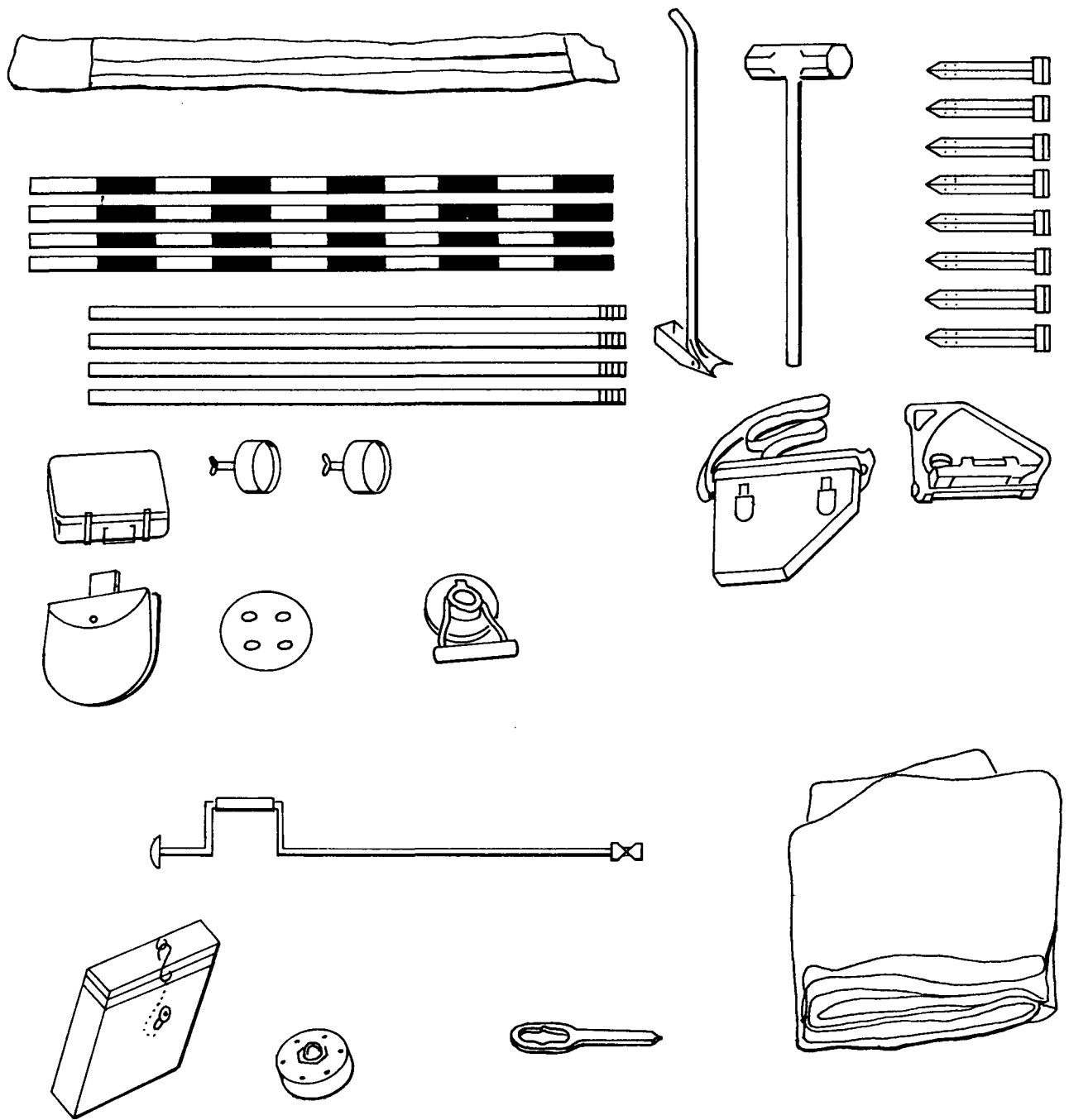


Figure 2. Section equipment, 105-mm howitzer light, M102, towed.

CHAPTER 2

SECTION DRILL

Section I. GENERAL

7. Purpose

This chapter prescribes the—

- a. Objectives and instructions for section drill.
- b. Commands and formations for section drill.

8. Objective

The objective of section drill is the attainment of efficiency; precision coupled with high speed.

9. Instructions

Section drill will be—

a. Conducted in silence except for commands and reports.

b. Repeated until reactions are automatic, rapid, and efficient.

c. Supervised so that mistakes are discovered, reported, and corrected immediately.

d. Supervised by battery officers to insure uniformity and efficiency.

e. Conducted so that each member of the section can perform all duties within the section.

Section II. COMMANDS AND FORMATIONS

10. Forming the Section

To form the section, the chief of section takes his post and gives one of the following commands:

- a. To form the section the command is FALL IN.

The section—

- (1) Moves at double time.
- (2) Forms in single rank at close interval, with the gunner on the right, the assistant gunner, the cannoneers in numerical order, and the driver at the left of the rank.
- (3) Centers on the chief of section at a distance of 3 paces (fig. 3).

b. To form the section in a particular place, the commands may be IN FRONT (REAR) OR YOUR PIECE, FALL IN. The section—

- (1) Moves and forms a single rank as in *a* above.
- (2) Faces the direction of fire.

c. To form the section in a particular direction the commands may be ON THE ROAD FACING THE PARK, FALL IN. The section—

- (1) Moves and forms a single rank as in *a* above.
- (2) Faces the direction indicated in the command.

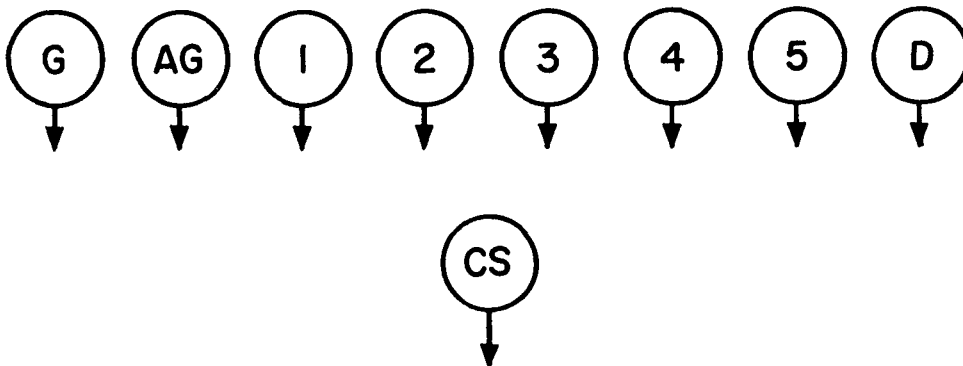


Figure 3. Section in formation.

d. At the first formation for a drill or exercise, the caution "As a section" precedes the command.

11. To Call Off

With the section in formation, the command is CALL OFF.

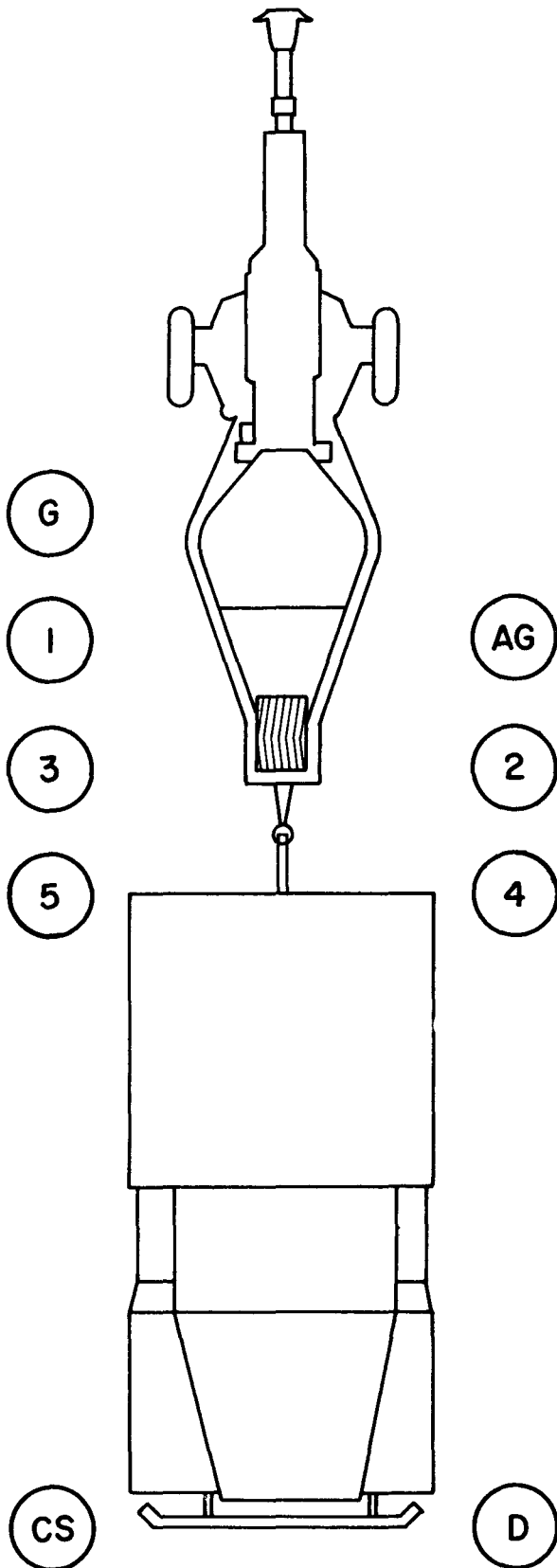


Figure 4. Posts, coupled.

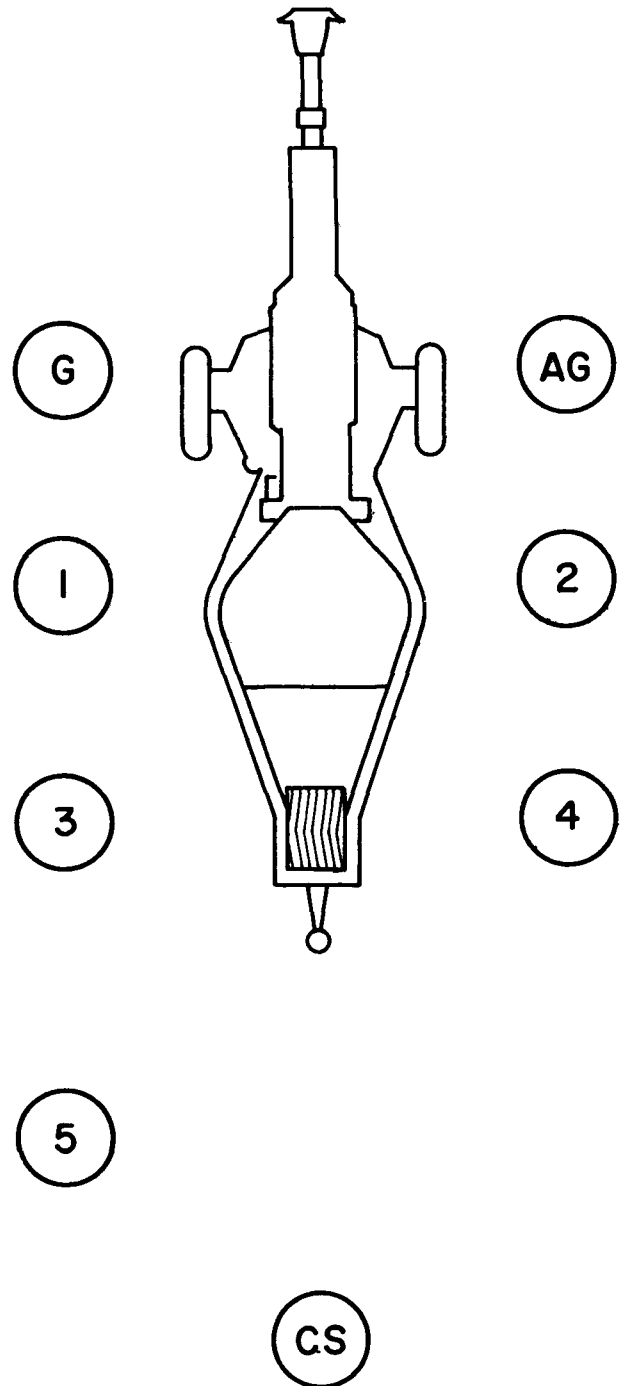


Figure 5. Posts, uncoupled, march ordered.

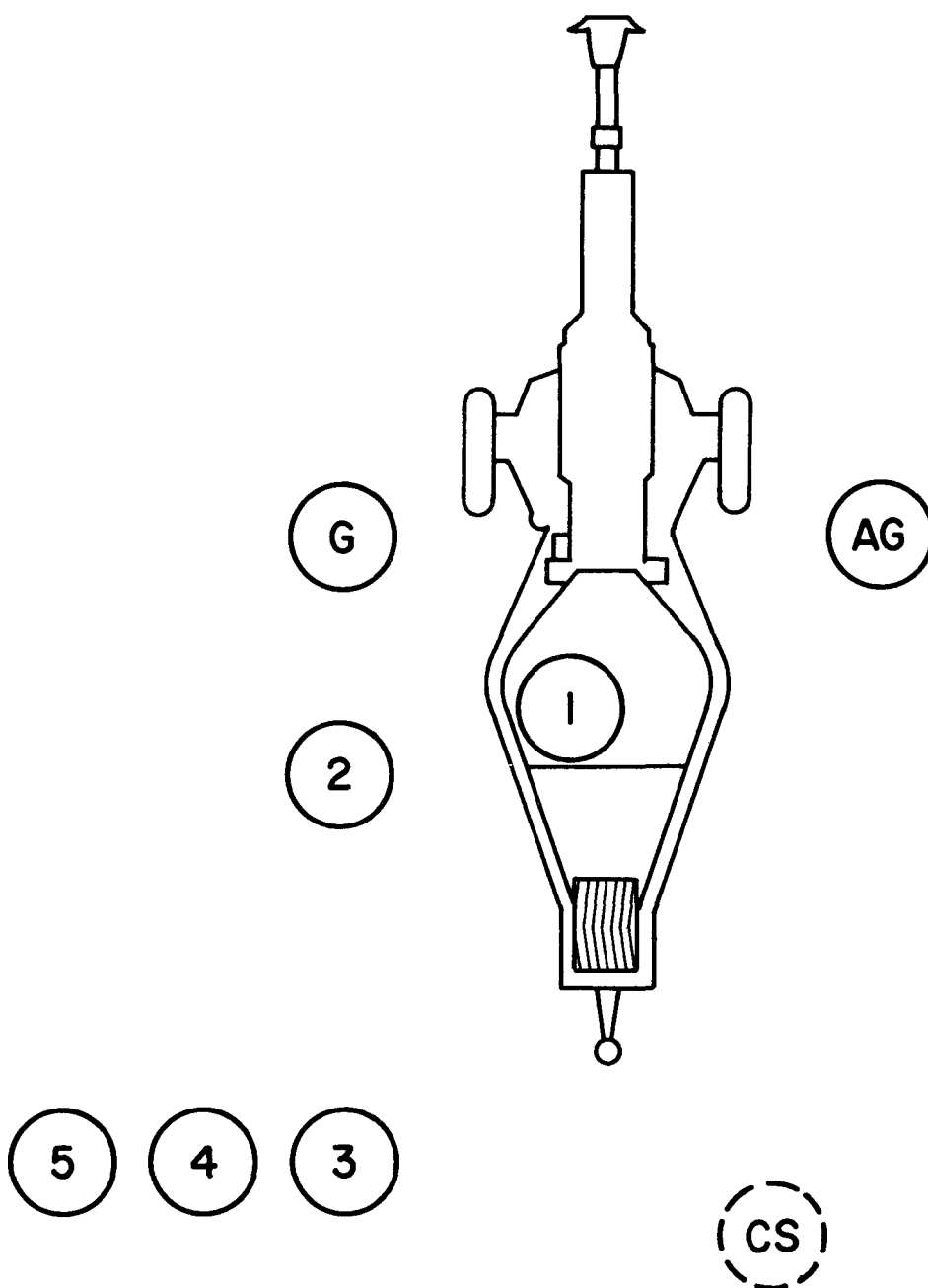


Figure 6. Posts, prepared for action.

a. All personnel except the gunner execute eyes right.

b. The section calls off in sequence: "Gunner, assistant gunner, 1, 2, 3, 4, 5, driver."

c. As each man calls out, he turns his head smartly to the front.

12. To Take Posts

The command is CANNONEERS, POSTS.

a. The command is general and may be given in or out of ranks, at a halt, or marching.

b. All movements are executed at double time and are terminated at the position of attention.

c. The section moves to posts as shown in figures 4, 5, and 6.

13. To Change Posts

Posts of section personnel should be rotated frequently so that all members of the section will be trained in all duties. With the section in *formation*, the commands are—

a. CHANGE POST, MARCH.

(1) Number 5 moves at double time to the post of the assistant gunner.

(2) The assistant gunner and numbers 1 through 4 take two left steps, each cannoneer taking the position of the next higher numbered cannoneer.

b. SECTION CHANGE POSTS, MARCH.

(1) The leftmost man moves at double time to the post of gunner.

(2) All other men move as in *a* above.

14. To Mount

To mount, the following commands may be given:

a. PREPARE TO MOUNT, MOUNT.

(1) At the preparatory command, the section moves at double time to positions shown in figure 4.

(2) At the command of execution, personnel mount and take positions as shown in figure 7.

(3) Each cannoneer is assisted by the man directly behind (or in front) to insure rapid mounting, and to prevent injuries.

(4) Before the chief of section mounts, he will verify that the load is properly coupled, that personnel and equipment are aboard and that the tail gate and safety strap are secure.

(5) If any member of the section is not to mount, he is designated and cautioned to

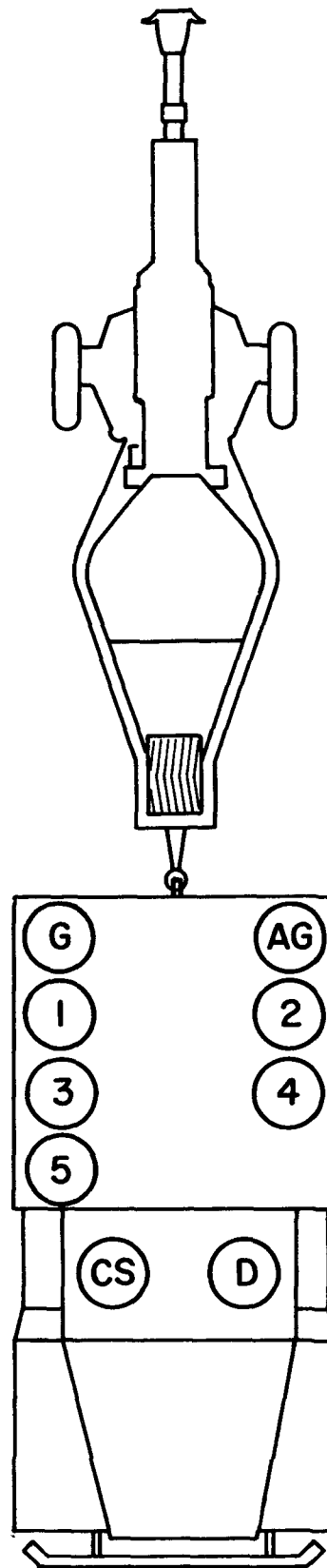


Figure 7. Posts, coupled mounted.

stand fast; e.g. PREPARE TO MOUNT, DRIVER
STAND FAST, MOUNT.

b. *MOUNT*. The section moves directly to the positions shown in figure 7.

15. To Dismount

To dismount the following commands may be given:

a. PREPARE TO DISMOUNT, DISMOUNT.

- (1) At the preparatory command, personnel assume a standing position in order to dismount rapidly.
- (2) At the command of execution, personnel jump to the ground and take positions as shown in figure 4.

b. *DISMOUNT*. The section moves without delay to positions as shown in figure 7.

16. To Fall Out

The command FALL OUT is given to provide rest and relief during drill or firing.

a. *During Drill*.

- (1) The command may be given at any time.
- (2) The section remains in the vicinity of the drill area.

b. *When Firing*.

- (1) The command may be given when firing is temporarily suspended.
- (2) The section remains in vicinity of, but clear of the piece.
- (3) The settings and layings are not disturbed.
- (4) The chief of section may require the section to improve the position area.

CHAPTER 3

DUTIES OF THE HOWITZER SECTION

Section I. PREPARATION FOR FIRING

17. Purpose

This chapter prescribes the duties for—

- a. Preparing the howitzer for firing (table I).
- b. Firing by indirect laying (table II).
- c. Firing by direct laying (table III).
- d. Preparing the howitzer for traveling (table IV).

Note. Tables I, II, III, and IV are located in back of the manual.

18. At the Position

a. The howitzer is emplaced under direct supervision of the chief of section.

b. Preparation of the firing position prior to occupation is governed by time and personnel available, and unit SOP. The following preparation will, however, facilitate the occupation of position:

- (1) Mark each howitzer position to indicate the place over which the panoramic telescope is to be located.
- (2) Place another stake at a distance of 50 to 100 meters, in the approximate direction of fire, at which the tube can be pointed.

c. The howitzer position should be free of any obstructions that will prevent easy traverse of the weapon.

Note. Large rocks, deep holes, or other obstructions will cause difficulty in traversing the weapon.

d. When position areas are to be occupied, and reconnaissance has not been possible, as may be the case in airborne or air assault occupations, a thorough map reconnaissance of the area to be occupied will assist the chief of section to plan and execute an orderly occupation of position.

19. To Prepare for Action

a. The command is PREPARE FOR ACTION.

- (1) The command may be given with the howitzer in position or approaching the position.
- (2) Duties of individuals are given in table I.
- (3) Each man takes his post (fig. 6) when he has completed his duties.

b. All duties are conducted at double time.

c. If the howitzer is not to be prepared for action at the firing position, a supplementary command DO NOT PREPARE FOR ACTION must be given.

20. Preparations for Traveling

The command is MARCH ORDER.

a. Duties of individuals are given in table IV.

b. Each man takes his post (fig. 4), when he has completed his duties.

Section II. FIRING

21. Firing by Indirect Laying

The vast majority of targets will be attacked by indirect laying. Indirect laying is a method of taking targets under fire by placing the line of sight of the panoramic telescope on an aiming point other than the target (infinity-aiming reference collimator). To provide timely and accurate fire, the section must be indoctrinated with a sense of urgency. Every effort must be made to execute the timely and effective delivery of fire. A detailed list of duties is contained in table II.

22. Firing by Direct Laying

Some targets may be attacked by direct laying. Direct laying is a method of taking the target under fire by sighting directly on the target. Since such targets are usually capable of returning fire, the following factors must be emphasized:

- a. Speed and accuracy in laying.
- b. High standards of training.
- c. Section operation as an independent unit.

23. Methods of Direct Laying

a. Sighting System. The two-man, two-sight system is the sighting system to be used with the M102 howitzer.

- (1) The gunner establishes lead with the panoramic telescope.
- (2) The assistant gunner establishes range with the elbow telescope.

b. Laying Method. Central laying is used in conjunction with click sights.

- (1) The gunner—
 - (a) Sets the lead on the azimuth counter.
 - (b) Traverses the tube until the vertical reticle of the telescope is on the center of the target.
 - (c) Makes subsequent changes in lead in 5-mil increments by sound (clicks) and feel when turning the azimuth knob.

- (2) The assistant gunner elevates or depresses the tube as required in order to place the range gauge line of the elbow telescope on the center of the target.

c. Tracking the Target. After lead and range are laid on the target, continuous tracking is maintained during the firing sequence.

d. Specific Duties in Firing. Specific duties in firing by direct laying are shown in table III.

24. Trajectory Characteristics

Trajectory characteristics for different ranges must be considered prior to taking a target under fire. Information contained in table V provides data, covering the effective direct fire ranges of the weapon. (Tables V in back of manual.)

Section III. AIRMOBILE OPERATIONS

25. General

The M102 howitzer has been designed for use in airmobile operations without modification or disassembly. The weapon may be transported internally or externally from a helicopter; air landed; or air dropped.

26. Responsibilities

a. Air Landed Operations. The unit commander responsible for delivering the weapon and associated equipment to the transport aircraft. Loading, positioning, lashing and tiedown of equipment is performed under the direction of the aircraft commander.

b. Air Delivery Operations. The rigging of equipment for air delivery is accomplished by the section under the supervision of specially trained parachute maintenance personnel. Derigging in the drop zone is accomplished by the howitzer section.

c. Helicopter Transport. Rigging of equipment for external helicopter transport is performed by the launcher crewmen and supervised by helicopter unit personnel when the situation permits. Internal loading is performed under the direction of the aircraft commander.

27. Rigging for External Load

a. Equipment. The following equipment is required for external transport of the howitzer—

- (1) Universal cargo slings.
- (2) Hookup rings.
- (3) Tape and padding as required.

b. Preparing the Howitzer for Lift.

- (1) Install the ends of the universal sling to each of the three lifting brackets on the howitzer. (One lifting bracket is located on each trail, and the third bracket is located on the tube yoke.)
- (2) Secure the universal sling to the hookup ring.
- (3) Determine that the hookup ring is properly located with respect to the sling in order to insure proper attitude when the weapon is lifted.

c. Hookup Procedure.

- (1) The signal man directs the helicopter to a hover slightly above the howitzer.
- (2) The hookup man secures the hookup ring to the helicopter cargo hook.
- (3) The signal man waves the helicopter off after determining that the load is in order.

d. Derigging. Derigging, as required, is accomplished by the section in the landing area.

CHAPTER 4

TECHNIQUES AND SITUATIONS THAT REQUIRE SPECIAL ATTENTION

28. Precision in Laying

a. Fire control instruments, fuze setters, and elevation and traverse mechanisms must be operated in a manner to reduce the effects of lost motion.

b. The gunner and assistant gunner will verify the laying after the breech closes.

c. For uniformity and accuracy—

- (1) The line of sight for setting and reading a scale or centering a bubble should be at a right angle to the scale or level vial to prevent parallax errors.
- (2) The corresponding number(s) (graduations) on the panoramic telescope must be matched with the corresponding number(s) on the reticle of the infinity-reference collimator, or the vertical reticle of the panoramic telescope must be alined with the left edge of the aiming posts.

29. Aiming Points

After the howitzer has been laid for direction, it is referred to a primary aiming point, normally the infinity-aiming reference collimator or the aiming posts and alternate aiming points (distant aiming points) as required.

a. An aiming point must be a sharply defined point or a clearly visible vertical line.

b. Alternate aiming points (distant aiming points) must be at least 2,000 meters distant. At this distance displacement as a result of firing or traverse will cause no more than a $\frac{1}{4}$ mil horizontal change in direction with the same settings on the scales.

c. The infinity-aiming reference collimator is an optical instrument which simulates an azimuth reference target at infinity. The collimator is alined with the vertical reticle of the panoramic telescope as directed by the gunner.

- (1) The collimator is emplaced in any convenient position, from 5 to 44 feet from the left side of the weapon.

- (2) While the howitzer is being laid, number 1 alines the optical system of the collimator on the center of the telescope rotating head and cross-levels the reticle pattern.
- (3) After the howitzer is laid the gunner directs number 1 in alining the 0 line of the collimator reticle with the vertical reticle of the panoramic telescope.
- (4) To lay for direction during firing, the gunner sets the announced deflection on the panoramic telescope and alines any number on the panoramic telescope reticle with the same number on the collimator reticle. This procedure for laying also compensates for weapon displacement during firing.

Note. For positive location, an area at least 7 mils in diameter must be seen at all times on the collimator reticle.

d. If the aiming posts are used as the primary aiming point, they are alined with the vertical reticle of the panoramic telescope as directed by the gunner.

- (1) The *far* aiming post is placed at least 100 meters from the piece. This distance is the most desirable for accuracy, visibility, and control of the aiming post reflectors.
- (2) The *near* aiming post must be set up half-way between the far post and the piece. Equal spacing is accomplished either by pacing, or by measuring with the panoramic telescope and using the aiming post as a stadia rod or by using a wire or cord with the appropriate distances marked in a convenient manner.
- (3) If the aiming post is used as a stadia rod, the procedure is as follows:
 - (a) Number 1 stands at the far aiming post and holds the upper section of an aiming post parallel to the ground and perpendicular to the line of sight.

- (b) The gunner measures the length of the aiming post in mils on the reticle of the panoramic telescope.
- (c) The gunner directs number 1 to move toward the piece and to emplace the near aiming post at a point where the upper section measures twice the number of mils it measured at the far aiming post.
- (4) For night use, the reference collimator is equipped with a light source for illuminating the reticle pattern. This light is controlled at the piece by the gunner.
- (5) When the aiming posts are used at night, an aiming post reflector is mounted on each aiming post. A beam of light from the panoramic telescope is projected along the line of sight of the telescope. When the aiming post reflectors are within the beam of light the reflected images serve as aiming points. The M2 reflector reflects a red tinted image which distinguishes it from the white image reflected by the M1 reflector. Unit SOP will determine which reflector is mounted on which aiming post.
- (6) Unit SOP will specify the deflection at which to place the reference collimator or aiming posts; however, placing either the collimator or the aiming posts to the left front of the howitzer reduces misalignment and permits maximum visibility.
- (7) Corrections for displacement of the reference collimator or the aiming posts from the recticle of the panoramic telescope are discussed in table II.

30. Range Card

a. The chief of section is responsible for the defense of his assigned sector. He should also be prepared to deliver fire in all sectors (directions).

b. During reconnaissance of the position and shortly after occupation of position, the chief of section should—

- (1) Measure or estimate the ranges to prominent terrain features and likely avenues of approach.
- (2) Establish reference points as required.
- (3) Prepare a range card (fig. 8).
- (4) As time permits, replace estimated ranges with more accurate ranges obtained by

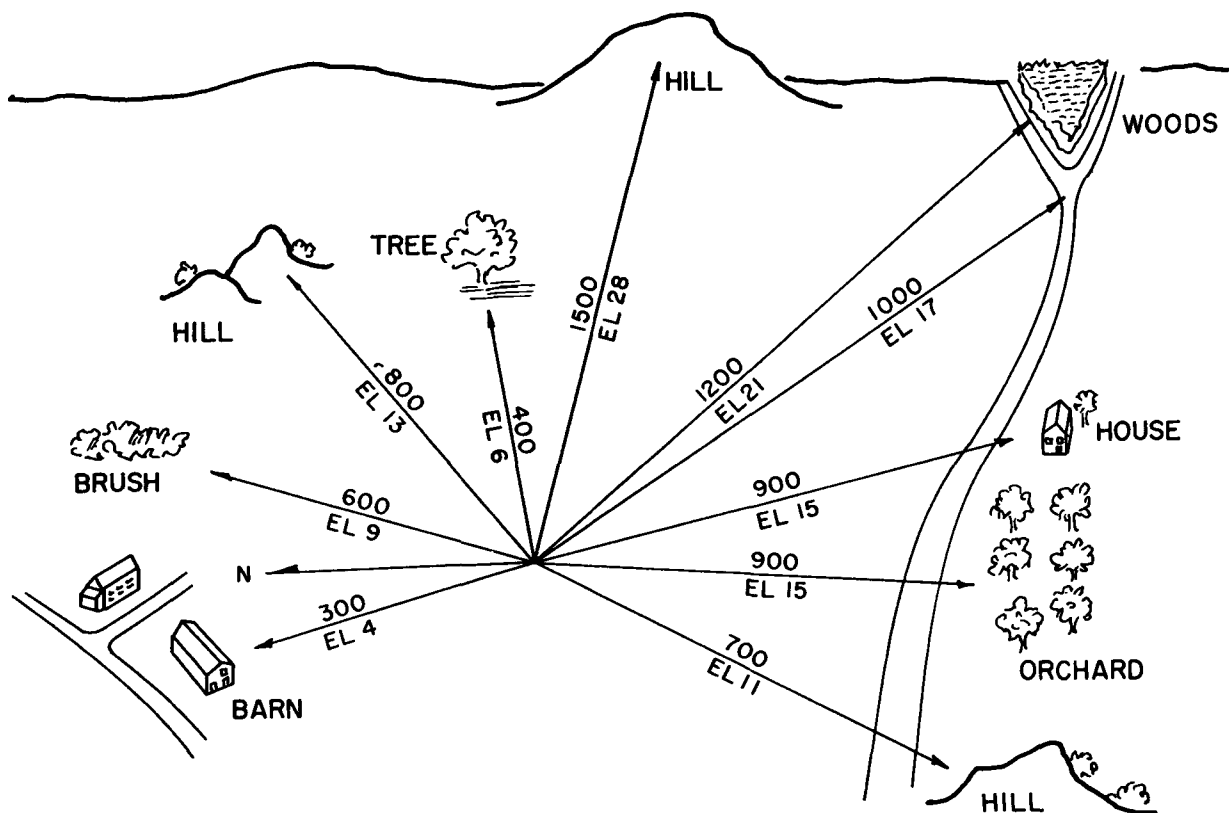


Figure 8. Range card for direct laying.

pace, pacing, taping, speedometer, maps, or survey.

c. The executive officer will assign numbers to certain prominent terrain features to facilitate target location. For example, the executive commands, TARGET THAT TANK, POINT NUMBER 2, FIRE AT WILL.

d. As time permits, a deflection and a quadrant for each numbered point should be added to the range card to expedite and increase accuracy in firing.

e. If possible, the field of fire of the section should be cleared of obstructions that might hinder firing or observation. Care must be taken not to expose the location of the position.

31. Changes in Data During Firing

If it is necessary to change any element of firing data, the executive commands CORRECTION.

a. *Piece Unloaded.* Set off new data and resume firing when the quadrant is announced.

b. *Piece Loaded.* If no change is required in the fuze, time setting, or charge, set off new data and resume firing when the quadrant is announced.

(1) If the data requires a change in the fuze, time setting, or charge, the chief of section will suspend firing and report to the executive, "Number () loaded, charge (), fuze (), time ()," stating the elements that are changed.

(2) In continuous fire, changes in data are applied without stopping the fire or breaking its continuity.

32. To Unload The Howitzer

a. Once a completed round is loaded, it should be fired. However, if unloading is required, the command is UNLOAD.

b. If the howitzer has been fired repeatedly and the tube is heated, it should be fired if possible. If it is necessary to unload the weapon, it should be unloaded as quickly as possible.

c. Unloading will be supervised by an officer, according to the following procedure.

(1) The assistant gunner opens the breech slowly.

(2) Number 1, standing at the breech, receives the ejected round.

d. If the extractor fails to eject the cartridge case, the procedure is as follows:

(1) Number 2 obtains the rammer staff and the unloading rammer head.

(2) The officer inspects the rammer head to insure that it is free from obstructions.

(3) Number 2 inserts the rammer into the bore until the head incloses the fuze and touches the projectile.

(4) Number 2 then pushes on the rammer, and taps the end of the staff lightly with a wooden block if necessary, until the round is dislodged.

(5) Number 1 receives the round as it is pushed out of the breech.

e. If the cartridge case is extracted but not the projectile, the procedure is as follows:

(1) Number 1 fills the powder chamber with waste and closes the breechblock.

(2) Number 2 dislodges the projectile as in d above.

(3) Number 1 opens the breech, removes the waste and receives the projectile as number 2 pushes the projectile to the rear.

33. Care of Ammunition

To insure uniform results in firing, to prolong the life of the tube, and to avoid accidents, great care must be exercised in handling and storing ammunition. The following requirements should be met.

a. Information contained in TM 9-1900 that is applicable to field service should be followed.

b. Protect the ammunition from damage.

(1) Raise ammunition stacked in the open 6 inches off the ground, and dig drainage ditches around the stacks.

(2) Use tarpaulins and dunnage to protect ammunition against weather, dirt, and sun.

(3) Allow a six-inch airspace between the top of the stack and the covering tarpaulin.

(4) Leave ammunition in containers until just prior to firing.

Note. Uniform propellant temperatures must be maintained to provide accurate firing.

c. Explosive elements in fuzes are particularly sensitive to shock and high temperature. The following precautions should be observed:

(1) Protect fuzes from weather, direct sunlight and rough handling.

(2) Remove protection and safety devices from fuzes just prior to firing.

(3) Do not attempt to disassemble a fuze.

d. Ammunition should be protected from hostile fire by—

(1) Dispersing ammunition in small stacks.

- (2) Storing ammunition in trenches and dug-outs.
- (3) Insuring that each stack of ammunition does not contain more than 75 rounds, and is not more than four layers high.
- (4) Placing stacks of ammunition at least 10 meters apart.
 - e.* Ammunition should be sorted into lot numbers as it is stored.
 - f.* For further information on care of ammunition, see FM 6-40, TM 9-1300-203, TM 9-1900, and TM 9-1015-234-12.

CHAPTER 5

BORESIGHTING

Section I. GENERAL

34. Description

Boresighting is—

a. The process to *verify*, and *aline* if required, that the optical axes of the panoramic telescope and the elbow telescope are parallel to the axis of the tube in deflection and elevation.

b. Conducted prior to firing and, during lulls in firing when the howitzer fires inaccurately for no apparent reason.

c. Performed to insure accuracy in laying for elevation and direction.

35. Methods of Boresighting

a. The methods of boresighting the M102 are the—

- (1) Testing target method (para. 37–39).
- (2) Distant aiming point method (para. 40–42).
- (3) Standard angle method (para. 43–45).

b. The method of boresighting to be used will be determined by the unit SOP and the time available.

36. Equipment

The equipment needed for boresighting is described as follows:

a. *Front and Rear Boresights.* Front and rear boresights are used to aline the tube on the testing target or distant aiming point.

b. *Testing Target.* The testing target (fig. 9) provides accurate aiming diagrams for the tube, the panoramic telescope, and the elbow telescope in boresighting and testing. The testing target is prepared as follows:

- (1) Mount the testing target on a flat piece of material and fasten it to a stand to provide stability.
- (2) Install a plumb line and mil scale for use in leveling or canting the target.
- (3) Draw vertical reference lines for use when the trunnions are not level. The testing target must be canted the same amount and in the same direction as the carriage.
- (4) To facilitate boresighting in darkness, bore a $\frac{1}{16}$ -inch hole through the center of each aiming diagram and cover each hole with a piece of heavy cloth. A flashlight is held against the material to provide an aiming point for blackout conditions.

c. *Tools.* Section equipment includes all necessary tools for boresighting and testing.

Caution: Use the proper tools to prevent damage to fire control equipment.

d. *Plumb Line.* The plumb line is used to level the trunnions for testing and to boresight the howitzer if time is not a factor. The plumb line is prepared as follows:

- (1) Suspend the line from any convenient location so that the muzzle of the howitzer can be placed at a distance of approximately 5 feet from the line. For a more complete test insure that the line is long enough to allow for the highest possible tube elevation.
- (2) Attach a weight to the end of the line for tautness and, to prevent the line from swinging, place the weight in a liquid filled container.

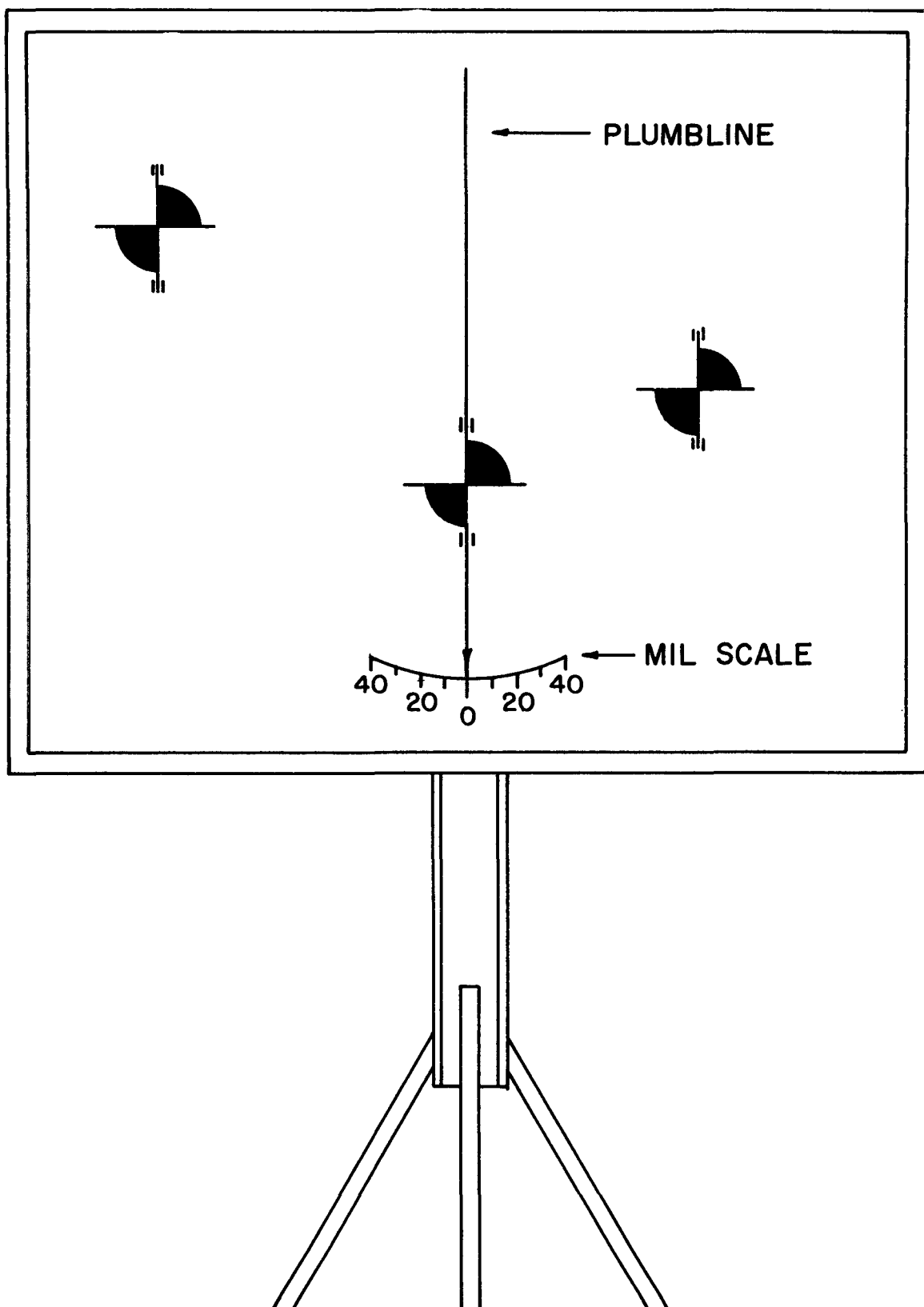


Figure 9. Testing target.

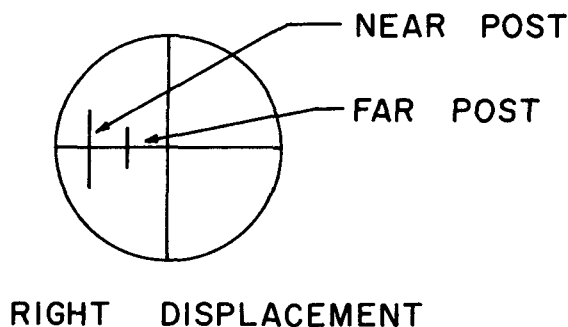
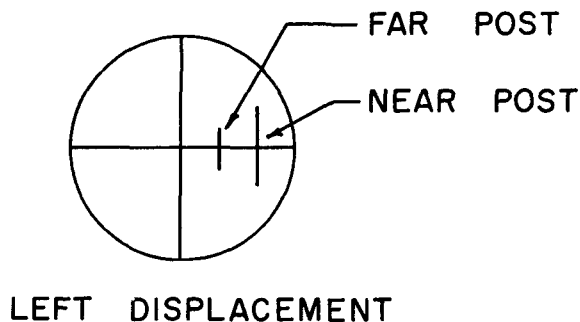


Figure 10. Correction for aiming post displacement.

Section II. TESTING TARGET METHOD

37. General

The testing target method consists of alining the line of sight of the tube, the panoramic telescope, and the elbow telescope with the aiming diagrams on the testing target.

38. Preparations for Boresighting

Preparations for boresighting are as follows:

- a. Place the howitzer on level ground.
- b. Place the tube in the center of traverse.
- c. Install the front and rear boresights (para. 36a).
- d. Level the trunnions by using a plumb line or a gunner's quadrant. The plumb line method is preferable, and the procedure is as follows:
 - (1) Install a plumb line (para. 35d).
 - (2) Traverse the tube until the plumb line is alined with the front and rear boresights.
 - (3) Elevate and depress the tube throughout its limits. The vertical hairline of the front boresight should remain in coincidence with the plumb line.
 - (4) If coincidence is not maintained, jack up the low axle until the vertical hairline on

the muzzle does track the plumb line.

- (5) Perform (3) and (4) above until coincidence is maintained throughout the elevation limits. The trunnions are now solid.
- e. The gunner's quadrant is normally used to level the trunnions under field conditions when time is critical. The procedure is as follows:
 - (1) Use a gunner's quadrant that has been checked by the end-for-end test.
 - (2) Set the index arm and the micrometer scale on the quadrant at zero.
 - (3) Place the quadrant on the breech block leveling pads that are perpendicular to the long axis of the tube.
 - (4) Jack up the low axle until the bubble on the gunner's quadrant is centered.
- f. Set the tube at zero elevation by using a gunner's quadrant and applying corrections, as determined from the end-for-end test.
- g. Center the pitch and cross-level bubbles on the panoramic telescope mount.

39. Boresighting Procedures With Testing Target

With the weapon prepared as in paragraph 38, boresight as follows:

a. Testing Target Location. Position the testing target at least 50 meters in front of the howitzer.

b. Testing Target Alinement. Without moving the tube, aline the center aiming diagram of the testing target with the line of sight through the tube. The testing target must be placed perpendicular to the axis of the bore. *The testing target must then be made secure.*

c. Panoramic Telescope Alinement.

- (1) Set the gunner's aid counters to zero.
- (2) Adjust the azimuth and elevation knobs on the panoramic telescope to lay the reticle precisely on the left aiming diagram.
- (3) Insure that—
 - (a) The muzzle crosshairs are centered on the center aiming diagram.
 - (b) The telescope mount is level.

- (4) The azimuth counter of the panoramic telescope should read 3200 mils. If the reading is not 3200 mils, turn the boresight adjustment shaft until 3200 appears in the counter window.

d. Elbow Telescope Alinement. After the procedures prescribed in *c* above have been performed—

- (1) Center the cross-level bubble.
- (2) Position range gage line of the elbow telescope on 0 elevation.
- (3) Determine if the reticle of the elbow telescope coincides with the right pattern of the testing target. If the reticle does not coincide with the target pattern, turn the adjusting screws on the site mount until coincidence is obtained.
- (4) If the telescope reticle cannot be brought into coincidence with the test target pattern, the mount must be adjusted by ordnance personnel.

Section III. DISTANT AIMING POINT METHOD

40. General

The distant aiming point method consists of alining the line of sight of the tube, the panoramic telescope and the direct fire telescope on a distant aiming point.

41. Preparations for Boresighting

a. Select a well-defined point at a distance of not less than 2,000 meters.

b. Follow the procedures prescribed for the testing target method (para. 39).

Note. Accurate leveling of the trunnions is not required for

boresighting on a distant aiming point.

42. Boresighting Procedures With Distant Aiming Point

a. Lay the line of sight of the tube on the distant aiming point.

b. Lay the reticles of the panoramic telescope and the direct fire telescope on the distant aiming point with the same sight picture observed through the tube.

c. Adjust the telescopes as required (para. 39c and d).

Section IV. STANDARD ANGLE METHOD

43. General

When combat conditions make the other methods of boresighting impracticable, the standard angle method may be used. In this method, the alinement of the optical axis of the panoramic telescope parallel to the axis of the bore is tested and adjusted by referring to a selected point on the muzzle. The deflection and elevation angles necessary to refer the line of sight of the telescope to the selected point on the muzzle are referred to as the standard angles. After the standard angles have been determined, they may be used for a quick test of the alinement of the panoramic telescope when more precise methods

cannot be used. Correction of misalignment, as a result of this test, should be verified by a more accurate method at the earliest opportunity. When the standard angle method of boresighting is used, the recoiling parts must be in the same position with respect to the nonrecoiling parts as they were when the standard angles were determined. Therefore, the recoil mechanism must be checked to see that it contains the proper amount of recoil oil before determining the standard angles. Standard angles are usable only as long as the same tube-carriage combination is intact. If either the tube or carriage is changed, new standard angles must be established.

44. Preliminary Operations

The ideal time to determine the standard angles for later use is after performing basic periodic tests when the trunnions are level and the panoramic telescope mount is known to be in correct alinement. Procedure for determining standard angles is as follows:

- a. With the tube in battery, scribe lines in the paint to mark the normal positions of the parts which move in recoil with respect to parts which do not move in recoil.
- b. Boresight the piece by using a testing target.
- c. With tape, fasten a bright, straight pin in the left horizontal witness mark on the muzzle. Allow the pin to project to the left of the muzzle.
- d. Position the parallax shield over the eyepiece of the panoramic telescope.
- e. Verify that the elevation counter dial reads zero mils and that the telescope mount is level.
- f. Turn the azimuth knob and elevate or depress the tube as necessary and place the crosshairs of the sight on the pin in the left horizontal witness mark of the tube.
- g. Verify that the telescope mount is level and that the horizontal and vertical lines of the telescope are exactly on the junction of the pin with the muzzle.
- h. Read and record the deflection from the azimuth counter dial of the panoramic telescope to

the nearest one-fourth mil. This is the standard azimuth angle for the piece tested.

- i. With the gunner's quadrant seated on the quadrant seats, measure and record the elevation of the tube to the nearest two-tenths mil. This is the standard elevation angle for the piece tested.

45. Procedure

a. After the standard angles have been determined and recorded, the standard angle method of boresighting is performed as follows:

- (1) Verify that the parts that move in recoil are in the same position with respect to the nonrecoiling parts as they were when the standard angles were determined.
 - (2) With tape, fasten a bright straight pin in the left horizontal witness mark so that the pin projects to the left of the muzzle.
 - (3) Position the parallax shield on the eyepiece of the telescope.
 - (4) Set off the standard elevation angle (para. 44i).
 - (5) Set off the standard azimuth angle on the azimuth counter dial of the panoramic telescope (para. 44h).
- b. If the intersection of the crosshairs of the panoramic telescope is not exactly on the junction of the pin and the muzzle, the sight is out of adjustment. If the azimuth angle is in error, the sight may be corrected by section personnel by adjusting the slotted key (boresight adjustment).

CHAPTER 6

BASIC PERIODIC TESTS

Section I. GENERAL

46. Purpose

Basic periodic tests are performed—

a. To determine whether the on-carriage sighting equipment, the gunner's quadrant, and the fuze setter are in correct adjustment.

b. By the section and the artillery mechanic under the supervision of the battery executive.

c. At the discretion of the unit commander. Suggested times are—

- (1) Once each year if the howitzer is used for nonfiring training.
- (2) Every 3 months if the howitzer is fired.

- (3) As soon as possible after intensive use, accidents, or travel in extremely rough terrain.
- (4) When fire is inaccurate for no apparent reason.

47. Preparations for Basic Periodic Tests

The following conditions must be established prior to conducting the tests:

- a. Place the howitzer on a site that is as nearly level as possible.
- b. Suspend a plumb line (para. 36d).
- c. Level the trunnions by using the plumb line.
- d. Boresight the howitzer by using the testing target.

Section II. TESTS OF GUNNER'S QUADRANT

48. General

The gunner's quadrant *must* be in proper adjustment to conduct the tests and adjustments on other sighting and fire control equipment.

49. End-for-End Test

The end-for-end test is conducted as follows:

a. Inspect the shoes on the gunner's quadrant for dirt, nicks, and burrs.

b. Inspect the quadrant seats on the howitzer for dirt, nicks, and burrs.

c. Zero the scales on the gunner's quadrant.

d. Place the quadrant on the quadrant seats. Depress and elevate the tube until the bubble in the gunner's quadrant is centered.

e. Reverse the quadrant on the seats and check the bubble. If the bubble centers, the quadrant is in adjustment, and the test is complete.

f. If the bubble does not center, turn the micrometer knob and try to center the bubble.

- (1) If the bubble centers, read the black figures on the micrometer scale and divide

by 2. *This is the correction for the gunner's quadrant.*

- (2) Place this correction on the micrometer scale, and level the tube.
- (3) Reverse the quadrant. The bubble should center.

g. If the bubble does not center as in f above, move the gunner's quadrant arm down one graduation (10 mils).

- (1) Turn the micrometer knob until the bubble centers.
- (2) Take the reading on the micrometer scale, add 10 to it, and divide the sum by 2. Place the result on the micrometer scale.
- (3) With the quadrant arm set at minus 10 and the above result set on the micrometer scale, place the quadrant on the quadrant seats and level the tube.
- (4) Reverse the quadrant. The bubble should center.

- (5) Subtract the reading on the micrometer scale from 10 to obtain the error.

Note. If an error is determined during the end-for-end test, the correction will be used only during the sighting tests and adjustments and will not be applied in fire missions. If the error exceeds 0.4 mil the quadrant must be sent to ordnance.

50. Micrometer Test

The micrometer test is performed as follows:

- a. Set the radial arm to read 10 mils on the elevation scale, and set the micrometer at zero.
- b. Place the quadrant on the quadrant seats with the line-of-fire arrow pointing toward the muzzle, and center the quadrant bubble by elevating the tube.
- c. Set the radial arm at zero, and set the micrometer at 10 mils.

- d. Reverse the quadrant; the bubble should center.

Note. Do not disturb the lay of the tube.

- e. If the bubble does not center, the *micrometer* is in error and must be adjusted by ordnance personnel.

51. Comparison Test

The comparison test is conducted in the following manner:

- a. Compare the readings as follows:
 - (1) Take readings at low, medium, and high elevations.
 - (2) Test *each* gunner's quadrant in the battery.
 - (3) Use the quadrant seats of a *single* piece.
- b. Compute the average reading at each elevation.
- c. Compare *each* quadrant reading with the average.
- d. Any quadrant differing more than 0.4 mil from the average reading must be adjusted by ordnance personnel.

Section III. TESTS OF ON-CARRIAGE FIRE CONTROL EQUIPMENT

52. Purpose

The purpose of the tests for the telescope mount, the telescope, and the elevation quadrant is to determine whether the azimuth counter and level vials actually establish the tube (regardless of cant) in the correct vertical plane at all elevations. These tests are performed to check the adjustment and mounting of the panoramic telescope mount, the accuracy of the level vials, and the alinement of the telescope socket. The test of the telescope mount described in paragraph 53 may be performed with the trunnions either level or canted. It reflects the total errors of the entire mechanism. Because compensating errors of various parts of the mount may result in the weapons's testing out properly, the other tests specified in paragraphs 54 and 55 must be performed regardless of the result of the test in paragraph 53. The total error found in this test may then be reduced to errors in specific components.

53. Test of Telescope Mount

The azimuth and vertical alinement tests for the telescope mount are conducted as follows:

- a. With the boresights in place and the tube as a low elevation, traverse the tube so that the line of sight through the tube is on the plumb line; level the telescope mount by centering both the pitch- and cross-level bubbles.
- b. Place the intersection of the panoramic telescope reticle on any sharply defined aiming point and note the deflection.

- c. Elevate the tube from minimum to maximum elevation (or limit of the plumb line) in 100-mil steps. At each step, traverse the tube (if necessary) to bring the line of sight back on the plumb line. Relevel the telescope mount in both directions and check for deviation of the line of sight from the aiming point. If the vertical is off the aiming point, realine the reticle on the aiming point with the azimuth knob. If the horizontal reticle is off the aiming point, realine the reticle on the aiming point with the elevation knob, and note the bubble displacement.

- d. If the vertical reticle deviates from the aiming point by more than one-half mil from the original deflection at any elevation tested or the correction for the deviation of the horizontal reticle causes either level bubble to move in excess of one-half vial graduation, the telescope mount is out of adjustment or improperly mounted. Refer the weapon to ordnance maintenance personnel for adjustment or correction.

54. Test of Cross-Level Setting, Telescope Mount

- a. Level the telescope mount by centering the pitch- and cross-level bubbles.
- b. Set the line of sight of the panoramic telescope at 3200 with the parallax shield in place.
- c. Suspend a plumb line to coincide with the vertical reticle of the telescope.
- d. Turn the elevation knob of the panoramic telescope through the entire range of movement. If the

line of sight deviates from the plumb line by more than one-half mil, the level vials are out of adjustment and must be adjusted by ordnance maintenance personnel.

55. Test of Longitudinal-Level Setting, Telescope Mount

- a. Level the telescope mount by centering the pitch- and cross-level bubbles.
- b. With the parallax shield in place, turn the azimuth knob of the panoramic telescope and set the line of sight to 1,600 mils.
- c. Suspend a plumb line to coincide with the vertical reticle of the panoramic telescope.
- d. Turn the cross-level correction knob on the telescope mount through the entire range of movement. If the line of sight deviates from the plumb line by more than 1 mil, the level vials must be adjusted by ordnance personnel.

56. Test for Panoramic Telescope

- a. Set the azimuth counter dial at 3200.
- b. Traverse and elevate the tube as necessary to place the panoramic telescope reticle on an aiming point.
- c. Rotate the telescope head through a complete

circle (6,400 mils). The telescope reticle should return to within 1 mil of the aiming point.

57. Test of Elevation Counter, Telescope Mount

Using a gunner's quadrant that has been checked for accuracy, compare the reading indicated on the gunner's quadrant with those on the elevation counter at low, medium, and high elevations of the tube. Turn the elevation knob until the elevation level bubble is centered at each elevation and insure that the cross-level bubble is centered. Check the readings of the elevation counter against the readings of the gunner's quadrant. If the two readings do not agree and the disagreement is constant at all elevations, the appropriate correction is applied to the elevation correction indicator dial. If the magnitude of the disagreement between the two readings varies with tube elevation, the elevation counter is out of adjustment and must be referred to ordnance maintenance personnel.

58. Test of Elevation Quadrant

The elevation quadrant is tested in the same manner as the elevation counter of the telescope mount (para. 57).

Section IV. TEST OF FUZE SETTERS

59. General

Examine the fuze setters as follows:

- a. Check for burred or dented edges—
 - (1) The stop that fits into the slot of the movable time ring.
 - (2) The adjusting pawl which engages the notch in the fixed fuze ring.
- b. Depress the adjustable pawl against its spring to determine that the movement of the pawl is free.
- c. Test the fuze setter with the fuze for which it was designed; the time scale on the fuze setter must have the same graduation as the time ring on the fuze.

60. Time Scale Test

The time scale test is performed to verify that the time set on the fuze agrees within prescribed tolerances with the time setting on the fuze setter. This

test may be conducted during firing or as a separate test.

a. The time set on the fuze should agree with the time setting on the fuze setter within one-fourth of the smallest graduation on the fuze time ring. The tolerances are—

- (1) 0.05 second for fuzes having 0.2 second graduation.
- (2) 0.125 second for fuzes having 0.5 second graduations.

b. If a fuze setting doesn't agree with the time set on the fuze setter proceed as follows:

- (1) Repeat the test as a check with a different setting.
- (2) If the fuzes and the fuze setter still don't agree, refer the instrument to ordnance.

c. Do not set any one live fuze more than twice.

d. When tests are complete, reset all fuzes to SAFE and replace the safety wire or cotter pin.

CHAPTER 7

MAINTENANCE AND INSPECTIONS

61. General

Systematic maintenance and inspection are essential to insure that—

- a. The howitzer section is prepared to carry out its mission immediately.
- b. Unexpected breakdowns are not experienced at a critical time when maximum performance is essential.
- c. Expensive and time-consuming repairs are reduced to a minimum.

62. Disassembly, Assembly, and Adjustment

Authorized adjustments and disassemblies to be performed by battery personnel are prescribed in TM 9-1015-234-12 and appropriate Department of the Army supply manuals. Deviation from these procedures is not authorized, except as permitted by the responsible ordnance officer.

63. Records

The principal records pertaining to the weapon are the Equipment Logbook, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) and DA Form 2407 (Maintenance Request). For detailed information on the use of these forms, see TM 38-750.

64. Maintenance

Detailed instructions for maintaining the howitzer are contained in TM 9-1015-234-12. Maintenance instructions for the prime mover are contained in the appropriate technical manuals and lubrication orders.

65. Inspection

- a. *The chief of section* should inspect his equipment *daily* and take immediate action to correct any deficiencies found.
- b. *The executive*, accompanied by the artillery mechanic, should make a *daily informal command inspection* on different parts of the weapon and carriage.
- c. *The executive* should make a thorough mechanical inspection of the weapon, auxiliary equipment, tools and spareparts, *at least once a month*.

66. Operational Services

A daily service is performed by the crew *each day* the vehicle or weapon is *operated*. This service is divided into three parts.

- a. *Before-operation service* is a brief service to determine if the vehicle and howitzer is ready for operation. At this time the chief of section verifies that sufficient ammunition, rations, tools, and equipment are available and secured.
- b. *During-operation service* consists of detecting any unsatisfactory performance of the vehicle or howitzer.
- c. *After-operation service* prepares the vehicle and the howitzer to operate again on a moment's notice. This is the basic daily service for the vehicle and howitzer, and it is particularly important to detect deficiencies that developed during operation. All defects that the driver and crew cannot remedy must be reported at this time. The chief of section will resupply, as required, ammunition and rations and verify that all equipment is present.

CHAPTER 8

DECONTAMINATION OF EQUIPMENT

67. General

a. Equipment that has been contaminated with chemical, biological or radiological agents constitutes a hazard to personnel and must be removed or neutralized.

b. Decontamination is the process of covering, removing, destroying, or changing the contaminating agent or agents into harmless substances.

c. Decontamination must be started as soon as possible in order to reduce hazards, and allow safe operation of equipment.

68. Decontamination of Toxic Chemical Agents

Table VI prescribes the methods for decontaminating toxic chemical agents.

Table VI. Decontamination for Toxic Chemical Agents

Contaminated object	Preferred decontamination methods	Alternate decontamination methods	Field expedient methods
Canvas-----	Boil in soapy water for 1 hour----- Use 5 percent solution of household bleach for V-agents. Use 5 percent solution washing soda for C-agents.	Immerse in boiling water for 1 hour. Launder by standard methods. Use DANC ¹ solution or DS2. ¹ Use slurry. ²	Aerate (except for V-agents).
Clothing-----	Immerse in boiling water for 1 hour, stir, add 1 pound of soap to each 10 gallons of water. Use 5 percent solution of bleach for V-agents. Use 5 percent solution of washing soda for G-agents.	Launder by standard methods. Dry clean. Use DS2 for cotton items only.	Rub M5 ointment on small contaminated areas. Aerate (except for V-agents).
Unpainted metals-----	Use DS2 or DANC, then rinse or wipe with organic solvent, ³ and dry.	Wash with cool soapy water ³ and rinse.	Aerate.
Painted metals-----	Spray with DS2 or DANC solution----	Wash with hot soapy water and rinse. (Slurry may be used if it is removed within 1 hour and the face is oiled.)	Aerate.
Instruments-----	Clean with alcohol (or gasoline) and apply a thin coat oil.	Wipe with rag dampened with DANC or DS2, dry with clean rag, and oil.	Weather.

¹ These decontaminants are injurious to plastic and hard rubber and should not be used in the bore.

² Equal weights of water and chloride of lime.

³ Organic solvents (Petroleum products) and water do not neutralize contaminants. Precautions must be taken to dispose of these solvents as contaminated materiel.

69. Decontamination of Biological Agents

Decontaminants and decontamination procedures for toxic chemical agents are usually effective against biological agents.

70. Decontamination of Radiological Agents

a. *Radioactive contaminants* cannot be made safe

by chemical action. They must be removed or shielded if it is impracticable to wait for natural decay.

b. *Decontamination* is the process of *reducing* the hazard by removing the contaminant or shielding against radiation. Methods are given in table VII.

Table VII. Decontamination for Radiological Agents.

Method	Contaminated object	Technique	Remarks
Wash and scrub with water.	All nonporous surfaces (metal, paint, plastics).	Work from top to bottom and up wind.	Drainage must be controlled—water is contaminated.
Detergent (soap) solution.	All nonporous surfaces.....	Heat water if possible. Rub surface and wipe dry. (Moist application is all that is desired, do not let drip).	Rags and runoff require disposal.
Organic solvents. (Petroleum products.)	All nonporous surfaces.....	Immerse or wash with solvent, then wash in hot soapy water and rinse with clear water.	Vapors are toxic. Fire precautions are required.
Brushing.....	Porous and nonporous surfaces.....	Brush, or sweep dust from equipment or clothing.	Limited control of contaminated dust. Wear protective mask.
Hot spots may be reduced by sanding, filing, or grinding. These methods are not practicable for large areas—A protective mask and gloves must be worn.			
Launder.....	Clothing.....	Use hot soapy water and rinse with clear water.	Water requires disposal.
Bathing and scrubbing....	Personnel.....	Use brushes, running water, and soap.	Continue scrubbing until contamination level is safe.

CHAPTER 9

DESTRUCTION OF EQUIPMENT

71. General

a. Tactical situations may arise in which it is necessary to abandon equipment in a combat zone. In such situations all equipment must be destroyed to prevent its use by the enemy.

b. *Equipment will be destroyed only on the authority delegated by a division or higher commander.*

72. Plans

A plan will be prepared by each battery to expedite destruction of equipment. The principles are as follows:

a. The plan must be adequate, uniform and easily executed.

b. Destroy essential parts first.

c. Destruction must be as complete as possible.

d. Destroy the *same* essential parts throughout the battery.

e. Destroy spare parts and accessories with the same priority as those installed on equipment.

73. Methods

a. The most generally applicable methods of destruction are—

(1) *Mechanical*—Requires ax, pick, sledge or similar equipment.

(2) *Burning*—Requires gasoline, oil, or other flammables.

(3) *Demolition*—Requires ammunition or explosives.

(4) *Gunfire*—Requires artillery, rocket launchers, rifle grenades, or hand grenades.

b. In general, destruction of essential parts followed by burning is sufficient to render the weapon useless.

74. Reference

Detailed information on destruction of the equipment is contained in TM 9-1015-234-12.

CHAPTER 10

SAFETY PRECAUTIONS

75. General

Safety precautions to be observed in training are prescribed in AR 385-63. Additional information is given in FM 6-40, FM 6-140, TM 9-325, and TM 9-1900. The more important safety precautions are summarized in this chapter.

76. Ammunition

The following precautions must be observed when handling ammunition:

- a.* Store ammunition in the firing area so that it is protected against accidental explosions.
- b.* Keep fire and flammables out of the area.
- c.* Protect ammunition from direct rays of the sun.
- d.* Do not disassemble fuzes.
- e.* Check all ammunition prepared for firing and not fired to insure that—
 - (1) Powder increments are present, in proper order, in good condition, and of the proper lot number.
 - (2) Lot number of the ammunition corresponds to the lot number on the container.
 - (3) Time fuzes are reset to SAFE and the safety wires are replaced.

77. Failure to Fire

If the weapon fails to fire—

- a.* Keep the weapon trained on the target.
- b.* Make two additional attempts to fire the weapon.
- c.* Clear unnecessary personnel from the vicinity of the howitzer.
- d.* Wait 2 minutes after the last attempt to fire.
- e.* The assistant gunner opens the breech and number 1 removes the cartridge case.
- f.* If the primer is dented, a faulty primer is indicated, and the cartridge case is replaced.
- g.* If the primer is not dented, a faulty firing mechanism is indicated.
- h.* For detailed procedures refer to TM 9-1015-234-12.

78. Drill and Firing

- a.* Load the weapon only when firing is imminent.
- b.* Personnel move in rear of the piece when going from side to side.
- c.* Personnel stay clear of recoil path.
- d.* Crew members should use ear plugs or cotton to protect ear drums.
- e.* A safety officer will be present during all firing in training exercises. Specific duties for the safety officer are listed in FM 6-40.

CHAPTER 11

TRAINING

Section I. GENERAL

79. Purpose

The purpose of this chapter is to present the minimum requirements for training the howitzer section. It includes—

- Information for conduct of training.
- Minimum training schedule.
- Gunner's qualification tests.

80. Conduct of Training

Section training is *conducted* by the section chief. Battery officers are responsible for preparing the training plans and for supervising their execution. The chief of section—

- Trains *each* member of his section to function smoothly and efficiently in *all duties* in the section.
- Welds the section into an effective, coordinated team, capable of functioning efficiently in combat.
- Emphasizes the application of prior instruction to current training.
- Maintains a progress card on each man to show—
 - Instruction attended.
 - Tests taken.
 - Remarks pertaining to progress.
- Refers to AR 611-201, ATP 6-100, FM 6-125, and FM 21-5 to insure that training requirements are met.

Section II. MINIMUM TRAINING SCHEDULE

81. Training Periods

a. The principles that should be followed in scheduling and preparing training periods are listed below:

- Arrange periods in service of the piece drill along with other battery training to provide a balanced training program.
- Conduct section drill in a vigorous manner not to exceed 30 minutes.
- Precede and follow howitzer drill with

logically related subject. For example, precede the drill period with tests and adjustments and follow with inspection and maintenance.

- Army Subject Schedule 6-3 provides uniform guidance for cannoneer training.
- Operational and maintenance characteristics of the weapon are described in TM 9-1015-234-12.
- The training schedule outlined in paragraph 82 is a guide to meet minimum training requirements.

82. Schedule

Method	Hours	Subject	Text reference	Training aids and equipment
C, D, PW	1-----	Organization and composition of gun section; general duties of individuals; formation of gun section.	Para. 2, 3, and 10. Tables I, II, III, and IV.	Gun and prime mover.
C, D, PW	1-----	Posts and posting of cannoneers; changing posts; mounting and dismounting.	Para. 10-15-----	Do.
C, D, PW	2 (1 hour periods)-----	Coupling and uncoupling; prepare for section, and march order; movement of gun by hand.	Tables I and IV-----	Do.

See footnotes at end of table.

Method	Hours	Subject	Text reference	Training aids and equipment
C, D, PW	24 (½ hour periods) -----	Gun drill, duties in firing, indirect laying.	Para. 20 and table II.	TOE equipment.
C, D, PW	9 (½ hour periods) -----	Gun drill duties in firing, direct laying.	Para. 21, 22, and table III.	Do.
C, D, PW	6 (1 hour and ½ hour periods).	Testing and adjustment of sighting and fire control equipment.	Para. 34-58 -----	Do.
C, D, PW	2 (½ hour periods) -----	Collimator and aiming post displacement correction.	Para. 29 and table II.	TOE equipment, black-board, and chalk.
C, D, PW	4 (1 hour periods) -----	Inspections and maintenance -----	Para. 61-66 -----	TOE equipment.
C, D	1 -----	Decontamination of materiel -----	Para. 67-70 -----	Decontamination equipment; TOE equipment.
C, D, PW	1 -----	Destruction of materiel to prevent use by the enemy.	Para. 71-74 -----	Demolition and TOE equipment.
C, D, PW	1 -----	Safety precautions -----	Para. 75-78 -----	TOE equipment.
PW	16 (4 hour periods) -----	Service, practice, indirect laying --	Para. 17-21, table II.	Do.
PW	4 -----	Service, practice, direct laying -----	Para. 22-24, table III.	Do.
C, PW	6 (1 hour periods) -----	Review and tests of subjects previously covered.	All previous references.	Do.

C-Conference; D-Demonstration; PW-Practical Work (78 hrs).

Section III. GUNNER'S QUALIFICATION TESTS

83. Purpose and Scope

This section prescribes the tests to be given in the qualification of gunners. The purpose of the tests is to—

a. Determine the relative proficiency of the *artillery soldier* while performing the duties of gunner for the 105-mm howitzer M102, light, towed. *The tests are not a basis for determining the relative proficiency of batteries or higher units.*

b. Serve as an adjunct to training.

84. Standards of Precision

The following standards are required of the candidate:

a. Counter settings must be exact.

b. Bubbles must be centered exactly.

c. The number on the panoramic telescope reticle will coincide exactly with the corresponding number on the collimator reticle.

d. Vertical reticle of the panoramic telescope must be alined on the left edge of the aiming post or on the same part of the aiming point or target each time the howitzer is laid.

e. *Final motions* must be made in the appropriate direction.

(1) *Counter settings* are made from lower to higher numbers.

(2) *Elevation* should be in the direction of the more difficult movement.

(3) *Traverse* is in the direction of the most resistance.

(4) Vertical reticle of the panoramic telescope is moved from left to right.

85. Assistance

a. The candidate will receive no unauthorized assistance.

b. The candidate may select assistants as authorized in the tests.

c. If an assistant or the examiner causes the candidate to fail a test, the test will be disregarded and another test of the same nature will be administered.

86. Time

a. The time allowed for each test is from the last word of the command to the last word of the candidate's report.

b. The candidate may begin the test after the first word of the first command.

87. Scoring

a. Scoring will be in accordance with the paragraphs entitled Penalties and Credit.

b. No penalty will be assessed in excess of the maximum credit allowed for each test.

88. Preparation for Tests

a. The howitzer will be prepared for action and the candidate will be posted in the position corresponding to the test or as indicated by the subparagraph entitled Special Instructions.

b. Examiner will insure that the candidate understands the requirements of the test.

c. Candidate reports "I am ready" before each test.

89. Qualification Scores

Minimum scores required for qualification in the courses are as follows:

Individual Classification	Points
Expert gunner.....	90
First-class gunner.....	80
Second-class gunner.....	70

90. Outline of Tests

Paragraph	Subject	Number of tests	Points each	Maximum credit
91	Direct laying, panoramic telescope.....	4	2	8
92	Direct laying, elbow telescope.....	4	2	8
93	Indirect laying, deflection only.....	18	2	36
94	Laying for quadrant with the elevation counter.....	3	2	6
95	Laying for quadrant with the gunner's quadrant.....	3	2	6
96	Displacement correction.....	2	-----	4
	Part I.....	(1)	3	(3)
	Part II.....	(1)	1	(1)
97	Measuring site to the mask.....	1	4	4
98	Measuring quadrant.....	1	4	4
99	Measuring deflection.....	1	4	4
100	Tests and adjustments of sighting and fire control equipment.....	5	-----	10
	Tests 1 and 2.....	(2)	1	(2)
	Test 4.....	(1)	2	(2)
	Tests 3 and 5.....	(2)	3	(6)
101	Materiel.....	3	-----	10
	Test 1.....	(1)	3	(3)
	Test 2.....	(1)	3	(3)
	Test 3.....	(1)	4	(4)

Total credit..... 100

91. Direct Laying, Panoramic Telescope

a. Scope of Tests.

- (1) Four tests (two groups of two tests each) will be conducted.
- (2) Tests 1 and 2 (and tests 3 and 4) will be executed as one series of commands.

b. Special Instruction.

- (1) Place a stationary target approximately 600 meters from the howitzer.
- (2) Set azimuth counter to 3,200 mils, and set gunner's aid counter to zero.
- (3) Point howitzer so that a 100-mil shift is required for tests 1 and 3.
- (4) Post the candidate as the gunner.
- (5) The laying of the piece will not be disturbed after tests 1 and 3.
- (6) The examiner will reverse the assumed direction of movement for test 3.

c. Outline of Tests.

Test Number	Examiner commands	Action of candidate
1 and 3	TARGET; THAT TANK, SHELL HE, CHARGE 7, FUZE QUICK, LEAD RIGHT 10, RANGE 800.	Sets lead on the azimuth counter. Traverses the tube until the vertical reticle is on the center of the target mass. Centers the pitch and cross-level bubbles. Commands FIRE and steps clear.
2 and 4	RIGHT (LEFT) 10, ADD (DROP) 200.	Sets off change in lead by using click sights. Traverses the tube until the vertical reticle is on the center of the target. Commands FIRE and steps clear.

d. Penalties. No credit will be allowed if, after each test—

- (1) The incorrect lead is set on the azimuth counter.
- (2) The vertical reticle is not centered on the mass of the target.
- (3) The pitch- and cross-level bubbles are not centered.

e. Credit.

Time in seconds, exactly or less

than.....5 6 7
Credit.....2.0 1.5 1.0

92. Direct Laying, Elbow Telescope

a. Scope of Tests.

- (1) Four tests (two groups of two tests each) will be conducted.
- (2) Tests 1 and 2 (and tests 3 and 4) will be executed as one series of commands.

- (3) The candidate will be tested as the assistant gunner in the two-man, two-sight system.

b. Special Instructions.

- (1) A stationary target will be placed approximately 600 meters from the howitzer.
- (2) For tests 1 and 3, the range gauge line as viewed through the telescope will be placed more than 100 meters away from the target.
- (3) The laying of the piece will not be disturbed after tests 1 and 3.

c. Outline of Tests.

Test Number	Examiner commands	Action of candidate
1 and 3.	TARGET; THAT TANK, SHELL HE, CHARGE 7, FUZE QUICK, LEAD LEFT 5, RANGE 600.	Places the range gauge line on the range commanded. Elevates the tube until the range gauge line is centered on the visible mass of the target. Calls "Set" and steps clear.
2 and 4.	ADD (DROP) 200-----	Same as test 1 above.

d. Penalties. No credit will be given if after each test, the correct range line is not on the center of the visible mass of the target.

e. Credit.

Time in seconds, exactly or less

than-----2 2½ 3

Credit-----2.0 1.5 1.0

93. Indirect Laying, Deflection Only

a. Scope of Tests.

- (1) Eighteen tests (two groups of nine tests each) will be conducted.
- (2) Tests 1 through 9 (and tests 10 through 18) will be executed as one series of commands.

b. Special instructions.

- (1) The examiner will identify an aiming point for the candidate.
- (2) Special corrections will be given *only* in the tests indicated in *c* below.
- (3) The deflection limits for each test are as follows:

Test number	Maximum change (mils)	Minimum change (mils)
2 and 11	180	140
3 and 12	90	70
7 and 16	100	60

Test number	Maximum change (mils)	Minimum change (mils)
8 and 17	50	30
9 and 18	20	10

- (4) The howitzer will be laid with the correct deflection at the conclusion of each test.
- (5) The reference collimator or the aiming posts will be set out at the deflection as determined by unit SOP.
- (6) The examiner will designate the section number and special corrections in deflection to be applied by the candidate.
- (7) The candidate will be posted as gunner.

c. Outline of Tests.

Test Number	Examiner commands	Action of candidate
1 and 10.	SPECIAL CORRECTIONS, DEFLECTION 3200, NUMBER 1 LEFT 7.	Sets deflection and applies special correction. Centers cross-level and pitch-level bubbles. Traverses the piece until corresponding numbers on the panoramic telescope coincide with those on the reference collimator. Checks centering of bubbles. Re-lays if necessary. Calls "Ready" and steps clear.
2 and 11.	DEFLECTION 3050-----	Sets deflection. Leaves correction on gunner's aid counter. Lays on reference collimator. Checks centering of bubbles. Re-lays if necessary. Calls "Ready" and steps clear.
3 and 12.	DEFLECTION 3130-----	Same as test 2 above.
4 and 13.	NUMBER 1 RIGHT 4.	Same as test 2, except he sets <i>right 4</i> on the gunner's aid counter.
5 and 14.	CEASE FIRE, END OF MISSION. (Operation is not timed.) AIMING POINT, CHURCH STEEPLE, REFER.	Sets gunner's aid counter to zero. Refers telescope to church steeple. Uncovers azimuth counter. Reads deflection and calls "Number 1, deflection ()."

Test Number	Examiner commands	Action of candidate
6 and 15.	DEFLECTION 3200 REFER.	Rotates azimuth knob until reset counter reads 3200. Verifies that the vertical reticle is on the church steeple. Calls "Number 1, deflection 3200 and steps clear."
7 and 16.	SPECIAL CORRECTIONS, DEFLECTION 3129. NUMBER 1 LEFT 6.	Same as test 1 above.
8 and 17.	DEFLECTION 3069----	Same as test 2 above.
9 and 18.	DEFLECTION 3071----	Same as test 2 above.

d. Penalties. No credit will be given if, after each test—

- (1) The deflection is not set correctly.
- (2) The cross-level and pitch-level bubbles are not centered.
- (3) The corresponding number(s) on the reticle of the panoramic telescope does not coincide exactly with the same number(s) on the reference collimator, or the vertical reticle of the panoramic telescope is not on the left edge of the aiming posts.
- (4) Last motion in traverse is not from left to right.

e. Credit. Time in seconds, exactly or less than—
 Tests 1, 10, 6, and 15.....12 13 15
 Other tests.....8 9 10
 Credit.....2.0 1.5 1.0.

94. Laying for Quadrant With the Elevation Counter

a. Scope of Tests. Three tests will be conducted.

b. Special Instructions.

- (1) Each test will require a change from 20 to 40 mils.
- (2) Commands in tests 2 and 3 will not be in multiples of 5.
- (3) Candidate will be posted as assistant gunner.
- (4) The setting on the elevation counter will be within 40 mils of the initial elevation.

c. Outline of Tests.

Test Number	Examiner commands	Action of candidate
1-----	QUADRANT 375-----	Sets quadrant on the elevation counter. Centers pitch- and cross-level bubbles. Calls "Ready" and steps clear.
2-----	QUADRANT 342-----	Same as test 1 above.
3-----	SPECIAL CORRECTIONS, NUMBER 1 UP 2, QUADRANT 363.	Same as test 1 above, except he sets <i>up 2</i> on the gunner's aid counter.

d. Penalties. No credit will be allowed if, after each test—

- (1) The quadrant is not set accurately.
- (2) The cross-level and pitch-level bubbles are not centered.
- (3) The last movement of the tube is not in the direction in which it is more difficult to elevate.

e. Credit.

Time in seconds, exactly or less

than.....4 5% 6%
 Credit.....2.0 1.5 1.0

95. Laying for Quadrant With the Gunner's Quadrant

a. Scope of Tests. Three tests will be conducted.

b. Special Instructions.

- (1) Gunner's quadrant will be set at zero for the first test.
- (2) Tests 2 and 3 will require changes from 30 to 60 mils.
- (3) Candidate will be posted to the left of and facing the breech and will be holding the gunner's quadrant.
- (4) An assistant will elevate or depress the tube as directed by the candidate.

c. Outline of Tests.

Test Number	Examiner commands	Action of candidate
1-----	QUADRANT 210-----	Sets quadrant elevation on the gunner's quadrant. Seats the quadrant. Directs his assistant to elevate or depress the tube until the quadrant bubble is centered.

Test Number	Examiner commands	Action of candidate
		Calls "Ready" and awaits verification of the laying.
2-----	QUADRANT 257-----	Same as test 1 above.
3-----	QUADRANT 193-----	Same as test 1 above.

d. *Penalties.* No credit will be allowed if, after each test—

- (1) Quadrant elevation is not set correctly.
- (2) Quadrant is not properly seated.
- (3) Quadrant bubble is not properly centered.
- (4) Last movement of the tube was not in the direction in which it is more difficult to elevate.

e. *Credit.*

Time in seconds, exactly or less

than-----6 6% 7

Credit-----2.0 1.5 1.0

96. Displacement Correction

a. *Scope of Test.* One test, consisting of two parts, is conducted.

b. *Special Instruction.*

- (1) Aiming posts will be set out at prescribed distances.
- (2) An assistant will be stationed by the far aiming post.
- (3) The examiner will require the candidate to lay the piece on an announced deflection and report "I am ready."
- (4) The piece will be moved so that a 5- to 10-mil aiming post displacement occurs.
- (5) The lay of the howitzer at the end of part I will not be disturbed for part II.

c. *Outline of Test.*

(1) *Part I.*

Examiner commands	Action of candidate
CORRECT FOR DIS- PLACEMENT.	Lays howitzer so that the far aiming post appears midway between the near aiming post and the vertical reticle of the telescope. Checks centering of bubbles. Re-lays if necessary. Calls "Ready" and steps clear.

(2) *Part II.*

Examiner commands	Action of candidate
ALINE AIMING POSTS.	Records deflection on the turret and announces "Deflection (), recorded." Directs assistant in alining aiming posts. Calls "Ready" and steps clear.

d. *Penalties.*

(1) *Part I.* No credit will be allowed if—

- (a) The far aiming post does not appear midway between the near aiming post and the vertical hairline of the telescope.
- (b) Cross-level and pitch-level bubbles are not centered.
- (c) Final motion of traverse was not from left to right.

(2) *Part II.* No credit will be allowed if—

- (a) Deflection is other than the announced deflection.
- (b) Aiming posts are not properly alined.
- (c) Vertical reticle of the telescope is not on the left edge of the aiming posts.

e. *Credit.*

Part I, time in seconds,

exactly or less than-----3 3 1/3 3 2/3 4

Credit-----3.0 2.0 1.5 1.0

Part II, no time limit

Credit-----1.0 --- --- ---

97. Measuring Site to the Mask

a. *Scope of Test.* One test will be conducted.

b. *Special Instructions.*

- (1) The howitzer, prepared for action, will be placed 200 to 400 meters from a mask of reasonable height.
- (2) The tube will be pointed 100 to 150 mils above the crest and 100 to 150 mils to the right or left of the highest point on the crest.
- (3) The candidate will be posted at the rear of the breach.
- (4) An assistant will traverse and elevate the tube as directed by the candidate.

c. *Outline of Test.*

Examiner commands	Action of candidate
MEASURE SITE TO MASK.	Sights along lowest element of the bore, and directs the movement of the tube until

Examiner commands	Action of candidate
	the line of sight just clears the highest point of the crest. Centers the cross-level and pitch-level bubbles. Reads the elevation from the elevation counter. Reports "Number (), sight to mask ()."

d. *Penalties.* No credit will be allowed if—

- (1) The line of sight along the lowest element of the bore does not just clear the highest point of the crest.
- (2) The cross-level and pitch-level bubbles are not properly centered.
- (3) Site is not announced correctly.
- (4) Last movement of the tube was not in the direction in which it is more difficult to elevate.

e. *Credit.*

Time in seconds, exactly or less than—

14	15	16	17
Credit—4.0	3.0	2.0	1.5

98. Measuring Quadrant

a. *Scope of Test.* One test is conducted.

b. *Special Instructions.* Prior to the test the examiner will lay the tube at a selected quadrant and will set the gunner's quadrant to zero.

c. *Outline of Test.*

Examiner commands	Action of candidate
MEASURE THE QUADRANT.	Places gunner's quadrant on the quadrant seats. Levels the bubble on the gunner's quadrant by raising the index arm and turning the micrometer knob. Announces "Number () quadrant ()" and hands quadrant to examiner.

d. *Penalties.* No credit will be allowed if—

- (1) The quadrant bubble is not centered when the quadrant is properly seated.
- (2) The quadrant is not announced correctly.

e. *Credit.*

Time in seconds, exactly or less than—

8	9%	10%
Credit—4.0	3.0	2.0

99. Measuring Deflection

a. *Scope of Test.* One test is conducted.

b. *Special Instructions.*

- (1) The piece will be laid on the reference collimator or the aiming posts.
- (2) An aiming point within 200 mils left or right of the reference collimator or the aiming posts will be designated and will be identified by the candidate.

c. *Outline of Test.*

Examiner commands	Action of candidate
NUMBER 1, AIMING POINT THAT (MARKER) REFER.	Centers the cross-level and pitch-level bubbles. Refers to aiming point. Reads deflection from the azimuth and reports "Number 1, Deflection ()," and steps clear.

d. *Penalties.* No credit will be allowed if—

- (1) The cross-level and pitch-level bubbles are not centered properly.
- (2) Vertical reticle of the telescope is not on the aiming point.
- (3) Deflection is not announced correctly.
- (4) The weapon is traversed.

e. *Credit.*

Time in seconds, exactly or less than—

5	5%	6	6%
Credit—4.0	3.0	2.0	1.5

100. Tests and Adjustments of Sighting and Fire Control Equipment

a. *Scope of Tests.* Five tests will be conducted in which the candidate will be required to—

- (1) Demonstrate the testing methods and authorized adjustment of sighting and fire control equipment.
- (2) Describe the action taken (send to ordnance) if adjustment is not authorized by the user.

b. *Special Instructions.*

- (1) The piece will be prepared for tests as indicated in chapter 6 of this manual.
- (2) Necessary items of equipment are bore-sights, testing target, gunner's quadrant, and plumb line.
- (3) An assistant will elevate or depress the tube at the direction of the candidate during tests 1 and 2, and will aline the testing target for test 5.

- (4) Tests will be conducted in numerical order.
- (5) The gunner's quadrant used for tests 1 and 2 will be used for tests 3 and 4 with the correction determined in test 1, provided the correction does not exceed 0.4 mil.
- (6) Adjustments on the telescope mount and linkage are as prescribed in TM 9-1015-234-12.
- (7) Tube will be leveled after test 2 and will not be disturbed thereafter.

c. Outline of Tests.

Test Number	Examiner commands	Action of candidate
1-----	PERFORM END-FOR-END TEST ON THE GUNNER'S QUADRANT.	Performs test as prescribed in paragraph 49. Calls "Correction () mils, quadrant serviceable, (unserviceable)" and hands the quadrant to the examiner.
2-----	PERFORM MICROMETER TEST ON THE GUNNER'S QUADRANT.	Performs test as prescribed in paragraph 50. Calls "Quadrant micrometer is (is not) in error."
3-----	TEST PANORAMIC TELESCOPE MOUNT AND TELESCOPE.	Performs tests as prescribed in paragraphs 52 through 56. Calls "Ready" when tests are complete.
4-----	PERFORM CHECK ON THE ELEVATION QUADRANT.	Performs check as prescribed in paragraph 58. Calls "Ready" when check is complete.
5-----	BORESIGHT THE HOWITZER.	Performs tests and makes adjustments as prescribed in paragraphs 37 through 39. Calls "Ready" and steps clear.

d. Penalties. The tests are not essentially speed tests. The prescribed times are to insure that the candidate performs the tests without wasted effort.

- (1) *Test 1.* No credit will be allowed if—
 - (a) The bubble in the gunner's quadrant does not center when checked by the examiner.
 - (b) The error (one-half of the angle that was indicated when the quadrant was first reversed and the bubble was centered,

using the index arm and the micrometer knob) is not announced correctly by the candidate.

- (c) The candidate fails to declare the quadrant unserviceable if the error exceeds 0.4 mil or fails to declare the quadrant serviceable if the error is 0.4 mil or less.
 - (d) The time to complete the test exceeds 2 minutes.
- (2) *Test 2.* No credit will be allowed if—
 - (a) The procedure is not followed correctly.
 - (b) The time to complete the test exceeds 1 minute.
 - (3) *Test 3.* No credit will be allowed if—
 - (a) The procedure is not followed correctly.
 - (b) The candidate does not declare the telescope mount unserviceable if bubbles are out in excess of one-half vial graduation.
 - (c) The candidate does not declare the telescope mount unserviceable if the readings disagree more than 0.5 mil.
 - (d) No time is prescribed for this test.
 - (4) *Test 4.* No credit will be allowed if—
 - (a) The procedure is not followed correctly.
 - (b) Candidate fails to notify the examiner if the reading on the gunner's quadrant disagrees with the elevation quadrant.
 - (c) No time is prescribed for this test.
 - (5) *Test 5.* No credit will be allowed if—
 - (a) The candidate fails to make indicated adjustments.
 - (b) The candidate does not adjust azimuth counter to read exactly 3,200.
 - (c) Direct fire telescope has not been alined properly.
 - (d) The time to complete tests and adjustments exceeds 4½ minutes.

e. Credit. If tests and adjustments are within prescribed limits, maximum credit will be given as follows:

Test	Points
1	1
2	1
3	3
4	2
5	3

Maximum Credit 10

101. Material

a. Scope of Tests. Three tests are performed.

b. Special Instructions.

- (1) *Test 1 and 2.* A paulin will be placed on the ground for layout of disassembled parts. The candidate will be allowed to select the tools prior to the test. The candidate may have an assistant to aid him in moving the breechblock.
- (2) *Test 3.* A complete set of lubrication equipment, and lubricants authorized for use by battery personnel will be made available. Lubricants will be clearly marked.

c. Outline of tests.

Test Number	Examiner commands	Action of candidate
1-----	DISASSEMBLE BREECH MECHANISM.	Performs operation as prescribed in TM 9-1015-234-12. Identifies all parts to the examiner.
2-----	ASSEMBLE BREECH MECHANISM AND FIRING LOCK.	Performs operation as prescribed in TM 9-1015-234-12.
3-----	PERFORM DAILY AND QUARTERLY LUBRICATION.	Selects proper lubricants and equipment. Shows how, when, and with which lubricant each point is serviced. (Actual lubrication is not performed.) Checks all lubricant levels.

d. Penalties.

- (1) The tests are not speed tests; however, times are prescribed to insure that the candidate performs the tests without wasted effort.
- (2) No credit will be given if the following time limits are exceeded:

Test	Time (minutes)
1	8
2	12
3	5

- (3) One-half point will be assessed for each component incorrectly identified in test 1. There are no prescribed times for identifying the components. However, the examiner may reduce the grade if the candidate demonstrates obvious unfamiliarity with the components.
- (4) One-half point will be assessed for each lubrication point missed, each lubricant improperly selected, and each lubricating device improperly selected.

e. Credit

Test	Points
1	3
2	3
3	4

Maximum Credit 10

APPENDIX

REFERENCES

AR 320-5	Dictionary of United States Army Terms.
AR 320-50	Authorized Abbreviations and Brevity Codes.
AR 385-63	Regulations for Firing Ammunition for Training Target Practice, and Combat.
AR 611-201	Manual of Enlisted Military Occupational Specialities.
AR 672-5-1	Awards.
AR 750-5	Organization Policies and Responsibilities for Maintenance Operation.
DA Pam 108-1	Index of Army Motion Pictures, Film Strips, Slides and Phono-Recordings.
DA Pam 310-series	Index of Military Publications.
FM 5-15	Field Fortifications.
FM 5-20	Camouflage, Basic Principles and Field Camouflage.
FM 5-25	Explosives and Demolitions.
FM 6-20-2	Field Artillery Techniques.
FM 6-40	Field Artillery Cannon Gunnery.
FM 6-125	Qualification Tests for Specialists Field Artillery.
FM 6-140	The Field Artillery Battery.
FM 17-50	Armor Logistics.
FM 21-5	Military Training.
FM 21-30	Military Symbols.
FM 21-40	Small Unit Procedures in Nuclear, Biological, and Chemical Warfare.
FM 21-60	Visual Signals.
FM 22-5	Drills and Ceremonies.
FM 31-70	Basic Cold Weather Manual.
ATP 6-100	Army Training Program for Field Artillery Units.
ATT 6-117	Training Test for Field Artillery Howitzer Battery, 105-mm or 155-mm.
FT 105-H-6	Firing Tables for Howitzer, 105-mm.
TM 3-220	Chemical, Biological, and Radiological Decontamination.
TM 9-238	Deep Water Fording of Ordnance Materiel.
TM 9-575	Auxiliary Sighting and Fire Control Equipment.
TM 9-1527	Ordnance Maintenance: Gunner's Quadrants M1 and M1918 and Machine Gun Clinometer M917.
TM 9-1590	Ordnance Maintenance; Fuze Setters, M14, M22, M23, M25, and M27.
TM 9-1900	Ammunition, General.
TM 9-2300	Artillery Materiel and Associated Equipment.
TM 9-1015-234-12	Operator and Organizational Maintenance Manual for Howitzer, Light, Towed, 105-mm, M102.
TM 9-2810	Tactical Motor Vehicle Preventive Maintenance, Supply Inspection, and Training Procedures.
TM 38-750	The Army Equipment Records System and Procedures.
SM 9-5-1315	Ammunition, 75-mm Through 125-mm.
SM 9-5-1390	Ammunition and Explosives, Fuzes and Primers.

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By Order of the Secretary of the Army:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

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The Adjutant General.

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NG: State AG (3); units—same as active Army except allowance is one copy to each unit.

USAR: None.

For explanation of abbreviations used, see AR 320-50.

Table I. Duties in Prepare for Action

Sequence	Chief of section	Gunner	Assistant gunner	Number 1	Number 2	Number 3	Number 4	Number 5
1	Commands PREPARE FOR ACTION. Supervises work of cannoneers during all activities.	Commands UNCOUPLE. Disconnects the howitzer light system from the prime mover. Unlatches the pintle.	Removes the howitzer tail light assembly and muzzle cover and places them in the section chest.	Grasp the right and left lifting handles respectively and lift the lunette from the pintle lowering the trail until the terra tire is on the ground.				
2	If the piece is to be moved by hand, commands: 1. PIECE FORWARD (BACKWARD) 2. MARCH. When the piece is in the firing position, commands HALT, and the piece is stopped.	Directs the piece with the lunette.	If the piece is to be moved up or down steep slopes, alternately set and release the hand brakes permitting the howitzer to pivot, moving in a zig-zag manner.		Grasps right side of trail at a convenient location. Moves piece in the approximate direction.	Graps left side of trail at a convenient location. Moves piece in the approximate direction.	Graps right lifting handle. Moves piece in the approximate direction.	Graps left lifting handle. Moves piece in the appropriate direction.
3	Insures that the area required for 360° traverse is clear of obstacles.			Removes pin and disconnects terra tire travel lock.	Removes lunette lock pin, turns lunette 180° to the firing position, and replaces locking pin.	Disconnects and secures gun travel lock. Releases and secures buffer travel lock.	Disconnects right suspension lock.	Disconnects left suspension lock.
4	Insures that all personnel are clear of the tube and firing platform. Commands number 1 to pull the actuator quick release lanyard.			At the command of the chief of section, pulls the actuator quick release lanyard and allows the firing platform to drop. CAUTION: Number 1 must stand to one side of the tube in order to prevent injury when the weapon (tube) drops.	Secures crank and cranks wheels past center point. Removes crank and places it with other equipment.	Assist numbers 4 and 5 by shifting the trail as directed when securing the firing platform.	Insures right hand brake is released. Assists number 5 to secure the firing platform in position.	Insures left hand brake is released. Assisted by number 4, drive sufficient stakes as directed by the chief of section, to secure the firing platform during firing. CAUTION: Extreme care must be exercised in order not to strike the howitzer with the hammer while driving the stakes.
5	In order to direct action other than to the front the chief of section may command ACTION REAR. If the command is ACTION RIGHT (LEFT) the howitzer is turned 90° in the approximate direction.						Grasp right and left lifting handles respectively and turn the howitzer 180° in a clockwise direction.	
6	Checks recoil system for proper amount of oil, verifies that no leaks exist and directs servicing as required.	Remove protective cover from panoramic telescope. Presses elbow release lever and moves telescope eyepiece to a convenient viewing position. Raises 90° prism cover to open position. Uncovers level vials. Uncovers azimuth 6,400 mil counter, sets counter to 3,200 and zeros the gunners aid. Levels the telescope mount. Checks functioning of traversing mechanism.	Removes cover from elbow telescope and elevation quadrant. Operates elbow telescope latches. Turns telescope to the firing position, and slides the telescope forward into the key ways and secures latches. Uncovers elevation quadrant level vials. Set elevation counter to zero, sets correction counter to zero. Levels the elevation quadrant. Checks functioning of elevating mechanism.	Prepares and emplaces the infinity—aiming reference collimator in a convenient location, approximately perpendicular to the direction of fire, from 5 to 44 feet from the left side of the weapon. Orients collimator on the panoramic telescope and cross-levels the reticle. Lays electrical cable from the collimator to the gunner's position. (If required, assembles aiming posts and places near left front of howitzer.)	Assisted by numbers 3 and 4, unloads and arranges ammunition and section equipment.	Assisted by number 4, spreads paulin to left rear of howitzer. Assists number 2 to unload ammunition and equipment.	Assists number 3 to spread paulin. Assists number 2 to unload ammunition and equipment.	Lays communication cable from the howitzer to the MX-155GT. Prepares the telephone for use and assures operation of communication equipment.
7			Assisted by number 1, cleans and dries the breech mechanism, chamber and bore.	Assembles the rammer staff and rammer head. Assists the assistant gunner to clear and dry the breech mechanism, chamber, and bore.				
8	Verifies the adjustments of the sighting and fire control equipment.	Test and aline fire control equipment (boresight)		Holds and emplaces the testing target as required.				
9	*Measures site to the mask, assisted by the assistant gunner— 1. Sights along lowest element of bore. 2. Directs the assistant gunner to elevate or depress the tube until the lowest element of the bore just clears the highest crest in the field of fire. 3. Directs the assistant gunner to center cross-level and elevation bubbles. 4. Reads elevation on elevation counter and reports to the executive "Sir, number () site ()." (Gunner's quadrant may be used.) 5. Records and announces minimum elevation for each charge to the gunner and assistant gunner.	*Lays howitzer for direction: 1. When the command is given identifying the aiming point, identifies aiming point through telescope, and announces "Number () aiming point identified." 2. Executive commands NUMBER () DEFLECTION (). 3. Sets announced deflection on the azimuth counter (top window). 4. Traverses piece until reticle pattern of telescope is centered on objective lens of aiming circle. 5. Checks that pitch- and cross-level bubbles are centered. 6. Reports to executive "Sir, number () ready for recheck." 7. Repeats steps in 3 through 6 above until executive announces, "Number () is laid." (Lay of tube will not be disturbed until an aiming point is established.)	Assists chief of section in measuring site to mask.	If the aiming posts are to be used, sets the far aiming post to the left front approximately 100 meters from the piece.				
10	*Indicates alternate aiming point to the gunner when one is designated by the executive. If an alternate aiming point is not designated, the chief of section should select a clearly defined point at a distance of at least 2,000 meters. This aiming point is to be used as directed by the executive or at such times when the collimator is rendered useless. Deflections read from the azimuth counter are recorded and reported to the executive and are used to maintain parallelism, until the collimator is reemplaced.	*Directs alinement of the infinity aiming reference collimator: 1. Illuminates reference collimator reticle, and refers the panoramic telescope to the center of the reticle. 2. Assisted by number 1, alines the vertical reticle of the panoramic telescope with the 0 line on the reference collimator. (Minor adjustments may be made by both the gunner and number 1, to insure exact coincidence.) 3. Pushes in and turns reset knob and sets reset counter to 3,200. 4. Records reading in azimuth counter window and closes the window. <i>Note.</i> The azimuth counter is used to lay the howitzer. The reading in this window reflects the angle required to place the tube parallel to the direction of fire. The reset counter is then used to establish a common deflection of 3,200. *Directs alinement of aiming posts if required. 1. Refers telescope to the far aiming post previously set out by number 1. 2. Directs number 1 by hand signals to aline near aiming post with the far aiming post and the vertical reticle. 3. Pushes in and turns reset knob and sets reset counter to 3,200. 4. Records reading in azimuth counter window and closes window. Lays on alternate aiming point: 1. The piece has been laid. 2. The executive may command AIMING POINT, LEFT FRONT, LONE TREE, REFER. 3. Without moving the tube, refers the sight to the aiming point. 4. Reads deflection from the azimuth counter and reports "Number (), deflection ()." <i>Note.</i> The executive may record the referred deflection for future use, or he may proceed as follows: 5. Commands COMMON DEFLECTION, 3,200. 6. Pushes on reset knob and turns counterclockwise until 3,200 appears on the reset counter. 7. Verifies that the line of sight is on the aiming point. 8. Closes window over azimuth counter. 9. Reads and sets subsequent deflections from reset counter.	Checks direct fire telescope: 1. Adjusts eyepiece diopter for convenient viewing. 2. Verifies functioning of telescope range gauge line.	Assists the gunner to orient the infinity-aiming reference collimator. Places the near aiming post midway between the piece and the far aiming post and sets it as directed by the gunner.				
11	Verifies that the howitzer is prepared for action. Reports to executive "Sir number () in order" or reports any defects that the section cannot remedy without delay.	<i>Note.</i> All cannoneers take posts after they have performed their specific duties.						

*These steps may be omitted during training when drill does not include laying of the piece.

Table 11. Duties in Firing, Indirect Laying

Sequence	Chief of section	Gunner	Assistant gunner	Number 1	Number 2	Number 3	Number 4	Number 5
1	Commands the section during firing and insures an efficient and safe operation.							
2	Follows fire commands and repeats commands to the section as required to insure efficiency and safety.	Sets and lays for deflection. 1. The command is DEFLECTION (). 2. Sets announced deflection on the reset counter by turning the azimuth knob. <i>Note.</i> Final deflections are set in increasing direction on the reset counter. 3. Traverses piece until a number on the telescope reticle is matched with the same number on the reference collimator reticle. <i>Note.</i> Final motion of traverse must be in the direction of most resistance. 4. Centers pitch and cross-level bubbles.	Sets and lays for quadrant. 1. The command is QUADRANT (). 2. Sets the announced quadrant on the elevation counter with the elevation knob. 3. Elevates tube until elevation level vial bubble is exactly centered. 4. Centers cross-level bubble. Opens and closes the breech. 1. Grasps the breech operating lever handle with the left hand, depresses the handle, and draws it toward the rear to open the breech. 2. Grasps the breech operating handle with the left hand, and pushes it forward until the breech is closed and the latch is engaged.	Loads the howitzer: 1. Steps toward number 3 with the left foot and receives the prepared round from number 3: <i>a.</i> Grasps the base of cartridge case with the right hand. <i>b.</i> Grasps the projectile in front of the rotating band with the left hand. 2. Loads at the command QUADRANT: <i>a.</i> Inserts round in the breech. <i>Note.</i> Avoid striking the fuze against any part of the howitzer. <i>b.</i> Pushes the round home with the right fist. WARNING: A fist must be used to protect fingers from being crushed when the breechblock is closed.	Fuzes projectiles: 1. The command is FUZE (). 2. Removes fuze or closing plug. 3. Inspects fuze socket for rust or dirt. 4. Removes or replaces supplementary charge as required. 5. Screws in designated fuze, using authorized fuze wrench. CAUTION: Do not hammer on a fuze wrench or use an extension handle. 6. Removes safety pull wire from time fuzes. With fuze setter M26, sets fuzes TSQ M54, TSQ M55, MT 67, TSQ M500, TSQ M501, TSQ M520. 1. Seats upper lug of fuze setter in the upper recess of the fuze. 2. Loosens wingnut on fuze setter, sets announced time on the appropriate time band. 3. Locks wingnut, places handle to horizontal, turns counterclockwise until a stop is felt and a click is heard. 4. Raises handle, removes setter, verifies setting. With fuze setter M28, sets fuze VT M513-series: 1. Seats stationary lug of setter into top recess of fuze. 2. Sets announced fuze setting on the fuze setter. 3. Turns setter clockwise until setter stops or a click is heard. 4. Removes setter and verifies setting. Sets selective super quick and delay fuzes. On fuze quick, verifies that letters S.Q. are alined with the slot on the setting sleeve. On fuze delay, turns setting sleeve with screwdriver until the slot is alined with the word DELAY. Combination time and super quick fuzes: For impact the command is FUZE M500 (or other fuze) QUICK. Verifies that the letter S on the setting ring is alined with the index on the fixed ring. CAUTION: A time fuze should be returned to ordnance after being set twice. <i>Note.</i> The wrench type fuze setter, M27, may be used to set time fuzes: Engage setter in fuze knoth and rotate in the direction of increasing readings until the time setting is opposite the index mark on the fuze. This type of setter should be used only when mechanical setters are not available.	Prepares propellant charge: 1. The command is CHARGE (). 2. Verifies the number of increments. 3. Removes increments that are higher numbered than the charge commanded. 4. Replaces remaining charges in the cartridge case in their numerical order. Fits projectile into its cartridge case assisted by number 5. <i>Note.</i> Care must be exercised to prevent damage to the lip of the cartridge case. Holds projectile upright for fuzing and fuze setting. 1. Selects proper projectile as commanded. 2. Holds the projectile firmly while Number 2 fuzes and sets the fuze. When directed reads and announces the time set on the fuze. Passes prepared round to Number 1 with his left hand under the cartridge case and his right hand under the projectile so that Number 1 can grasp the base of the cartridge case. <i>Note.</i> Insure that the projectile and the cartridge case do not separate.	Remove ammunition from containers and arrange them within easy reach of number 3. 1. Remove the tape from the cartridge end of the container and tilt it so that the cartridge case can be taken by Number 3. 2. Reverse container, remove the tape, and tilt it so that Number 2 can receive the projectile. Inspect and clean projectile: 1. Examine rotating band to see that it is free from all dirt and burrs. <i>Note.</i> Projectile with burred rotating band will be put aside until the burrs can be removed with a file. 2. Examine entire projectile for defects. 3. Stand projectile on end and clean it thoroughly. <i>Note.</i> Any sand, dirt, oil, or grease on the projectile will cause wear, scratches, or gouches in the bore. Assists Number 3 in preparing charges. Install the muzzle brake as directed when firing charge 8.	
3	Indicates that the howitzer is ready to fire after the assistant gunner calls "Set" and the gunner calls "Ready," by extending his right arm vertically and reporting "Number (), Ready." <i>Note.</i> The chief of section will hold the unused propellant increments in his right hand.	Calls "Ready," after the piece is laid for direction and the assistant gunner calls "Set."	Calls "Set."	Notes. Care and proper handling of ammunition must be insured. It is imperative that— 1. There be no smoking in the vicinity of ammunition. 2. Only flashlights be used in vicinity of charges. 3. Rough handling of projectile, cartridge cases, and fuzes be prevented. 4. Projectiles and cartridge cases not strike together. 5. Ammunition not become dirty, wet, or over heated.				
4	Gives the command to fire by dropping his arm sharply to his side and commanding FIRE.		At the command and signal of the chief of section, fires the howitzer with a quick strong pull on the lanyard.	<i>Note.</i> 1. Number 1 remains inside the trail during firing. However, to avoid possible injury during recoil, number 1 must stand at the point of widest curvature. 2. Avoid sitting on the trail during firing. The terra tire will yield causing the quadrant settings to change.				
5	Observes and checks functioning of materiel during firing: Insures that the stakes securing the firing platform remain in place. Reports promptly to the executive any mistakes, unusual incidents, equipment malfunctions, and any reason the howitzer may not be fired.			Recovers expended cartridge cases and throws them to the right rear of the howitzer where they will be out of the way of the section. Inspects the bore and chamber after each round is fired to see that it is free from residue left by the charge and calls "Bore clear." Calls out number and quadrant for each round in volley fire.				
6	Lays for quadrant with gunner's quadrant: 1. The command is USE GUNNER'S QUADRANT. 2. The announced quadrant is set on the gunner's quadrant. <i>Note.</i> Increments of 10 mils are set on the quadrant frame arc. Mil and 0.1 mil increments are set with the micrometer knob. The same side of the quadrant must be used for settings on the quadrant frame arc and micrometer. 3. After the howitzer is loaded and laid for direction— Stands squarely opposite quadrant seats. Places and holds gunner's quadrant firmly on the seats. Insures that the words <i>line-of-fire</i> are on the bottom of the quadrant and the line of fire arrow is pointed toward the muzzle and is on the same side of the quadrant as the scale used. 4. Directs the assistant gunner to elevate the tube until the bubble is centered. Cautions the assistant gunner when the bubble is approaching center so that the final centering may be expedited. <i>Note.</i> For subsequent settings, the chief of section will take the same position, hold the quadrant in the same manner, and view the quadrant bubble from the same angle to insure consistency in leveling. Measures the quadrant: 1. The command is MEASURE THE QUADRANT. 2. With the piece laid, directs the assistant gunner to center the cross-level bubble and turn the elevation knob until the bubble in the elevation level vial is centered. 3. Reads the quadrant in the elevation counter window. 4. Reports to executive officer "Number () quadrant ()." <i>Note.</i> The quadrant can also be measured by placing the gunner's quadrant on the breech quadrant seat and centering the bubble by moving the index arm and turning the micrometer knob. Conducts prearranged fires in conformity with prescribed data (e.g., barrages, harassing, and interdiction fires). Commands CEASE FIRING. 1. Command may be given by anyone. 2. All firing will stop immediately. 3. If the howitzer is loaded reports that fact to the executive, who will acknowledge with "Number () loaded." 4. The executive will then investigate the cause, correct it, and resume firing by announcing the quadrant. 5. If CEASE FIRE is commanded by the fire direction center, fire is resumed by announcing the quadrant.	Corrects for aiming post displacement when the vertical reticle in the panoramic telescope is displaced from the line formed by the aiming posts. He lays the howitzer so that the far aiming post appears exactly midway between the near aiming post and the vertical reticle. <i>Note.</i> When using the reference collimator, matching the SAME number on the telescope and the collimator reticles in the direction of displacement, compensates for any displacement. <i>Left displacement.</i> <i>Right displacement.</i> Figure 10. Correction for aiming post displacement. <i>Note.</i> If displacement is caused by traversing, lay as described above. If displacement is caused by shifting of the carriage due to firing shock— 1. Lay as above until there is a lull in firing. 2. Notify chief of section for permission to realine the aiming posts. 3. Lay howitzer as described above. 4. Direct Number 1 to move the far post into alinement with the vertical reticle and then aline the near aiming post. Refers the piece: 1. The executive commands AIMING POINT THIS INSTRUMENT (or other point) REFER. 2. Does not disturb the lay of the tube. 3. Checks centering of bubble. 4. Refers sight until the vertical reticle is on the designated point. 5. Opens the azimuth counter door. 6. Reads from the azimuth counter and reports to the executive "Sir Number (); deflection ()." <i>Notes.</i> 1. Each time the weapon is traversed, the gunner must center the pitch and cross-level bubbles on the panoramic telescope mount, and the assistant gunner must insure that the elevation-level bubble and the cross-level bubble are centered each time the weapon is elevated or depressed. 2. Individual piece corrections will normally be added to the common deflection and quadrant, and the total deflection and quadrant are announced to each piece (e.g., deflection number 1,3030, quadrant, numbers 1,337.) The gunner's aid counter and correction counter windows should, therefore, normally read zero. However, it may be necessary for the assistant gunner to carry a correction on the correction counter of the elevation quadrant due to errors found while performing end-for-end test. (See TM 9-1015-234-12.)						

Table III. Duties in Direct Laying

Sequence	Chief of section	Gunner	Assistant gunner	Numbers 1 through 5																							
1	Conducts fire of howitzer: 1. Takes control of his section and directs the howitzer when the executive commands TARGET, TANK, RIGHT (LEFT) FRONT, FIRE AT WILL or simply FIRE AT WILL. 2. Alerts section to prepare for direct fire.	Prepares panoramic telescope for direct laying: 1. Uncovers window on azimuth counter. 2. Sets azimuth counter to 3,200. 3. Verifies gunner's aid counter is zero. 4. Turns direct fire lead knob so that DIRECT is visible. 5. Centers pitch and cross-level bubbles.	Prepares elbow telescope: 1. Centers bubble in elevation vial with the elevation knob. 2. Centers bubble in cross-level vial. 3. Checks functioning of range gauge line.	Perform the same duties as in indirect laying.																							
2	Identifies or selects target: 1. Identifies target designated by executive. 2. If target is a group of vehicles, selects the target that is the greatest threat to his position or the supported position based on this priority. a. Tanks at short range threatening to overrun the position. b. Hull down stationary tanks covering the advance of other tanks. c. Area containing personnel threatening to overrun the position. 3. Repeats target designation to the section "Lead tank," "Moving tank." Takes post to the flank and slightly to the rear of the piece where his observation will not be obscured by muzzle blast and smoke. Estimates range to target: 1. A range card (fig. 8) with accurate measurements to key points provides the most accurate ranges. 2. Estimated ranges are used if accurate measurements are not available. <i>Note.</i> The scales on the reticle of the direct fire telescope provide a direct range setting for the HEP-T M327 cartridge, and the M482 cartridge. If other types of ammunition are to be used in direct fire, the chief of section must provide the assistant gunner with a quadrant on which to place the direct fire telescope range line. Determines lead in mils: Lead is based on target speed, range, direction of travel, and ammunition used. Approximate initial leads are as follows: <table><tr><th rowspan="2">Speed (MPH)</th><th colspan="2">Lead (mils)</th></tr><tr><th>Target traveling perpendicular to line of fire</th><th>Target traveling 45° to line of fire</th></tr><tr><td>Slow 5</td><td>5</td><td>5</td></tr><tr><td>10</td><td>10</td><td>5</td></tr><tr><td>Medium 15</td><td>15</td><td>10</td></tr><tr><td>20</td><td>20</td><td>15</td></tr><tr><td>Fast 25</td><td>20</td><td>15</td></tr><tr><td>30</td><td>30</td><td>20</td></tr></table>	Speed (MPH)	Lead (mils)		Target traveling perpendicular to line of fire	Target traveling 45° to line of fire	Slow 5	5	5	10	10	5	Medium 15	15	10	20	20	15	Fast 25	20	15	30	30	20			
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3	Gives initial commands— <table><tr><th>Sequence</th><th>Element</th><th>Example</th></tr><tr><td>1</td><td>Target designation</td><td>TARGET (TANK etc.)</td></tr><tr><td>2</td><td>*Projectile, charge and fuze.</td><td>SHELL HEP-T (no charge or fuze required) SHELL HE, CHARGE 8 FUZE QUICK or SHELL HE, CHARGE 8, FUZE DELAY.</td></tr><tr><td>3</td><td>Lead.....</td><td>LEAD, RIGHT (LEFT) 10.</td></tr><tr><td>4</td><td>Method of fire....</td><td>Fire is continuous unless otherwise commanded.</td></tr><tr><td>5</td><td>Range.....</td><td>RANGE 600.</td></tr></table>	Sequence	Element	Example	1	Target designation	TARGET (TANK etc.)	2	*Projectile, charge and fuze.	SHELL HEP-T (no charge or fuze required) SHELL HE, CHARGE 8 FUZE QUICK or SHELL HE, CHARGE 8, FUZE DELAY.	3	Lead.....	LEAD, RIGHT (LEFT) 10.	4	Method of fire....	Fire is continuous unless otherwise commanded.	5	Range.....	RANGE 600.	Sets initial lead on the azimuth counter. Traverses howitzer until the vertical reticle is centered on the target and maintains this sight picture by continuous tracking of the target. Commands FIRE, after the assistant gunner calls "Set." <i>Note.</i> The gunner and assistant gunner track the target in deflection and elevation, as a team, while adjusting for the correct sight picture. They will continue tracking after the round is fired and make corrections as directed by the chief of section.	Moves the range line on the telescope reticle, along the proper ammunition scale, to the range commanded by the chief of section. Elevates or depresses the tube until the target is on the range gauge line. Maintains target on the range gauge line by continuous tracking. Calls "Set." <i>Note.</i> The reticle of the direct fire telescope contains scales for the HEP-T, M327 round; the M482 round; and a mil scale to be used when a quadrant, rather than a range is commanded by the chief of section.	Number 1 fires the piece when gunner commands FIRE.					
Sequence	Element	Example																									
1	Target designation	TARGET (TANK etc.)																									
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3	Lead.....	LEAD, RIGHT (LEFT) 10.																									
4	Method of fire....	Fire is continuous unless otherwise commanded.																									
5	Range.....	RANGE 600.																									
4	Gives subsequent commands based on observed effect— 1. Change in lead (given RIGHT (LEFT) 5 in 5-mil increments). 2. Change in range..... ADD (DROP) 100	Actions taken for subsequent commands. While the gunner and assistant gunner continued to track the target, the chief of section gives commands based on observed effects. When the chief of section commands—RIGHT (LEFT) (). 1. Turns azimuth knob in 5-mil increments to set the lead change as directed. <i>Note.</i> With the click sights, the gunner can determine by sound and feel the appropriate change has been made without moving his eye from the telescope eyepiece. 2. Traverses the piece until the vertical reticle is again centered on the mass of the target. 3. Checks that the pitch- and cross-level bubbles are centered. 4. Commands FIRE, after the assistant gunner has called "Set."	When the chief of section commands—ADD (DROP) (). 1. Moves the telescope range gauge line to the range as corrected by the chief of section. 2. Elevates or depresses the piece until the range gauge line is centered on the mass of the target. 3. Calls "Set." <i>Note.</i> During the laying sequence, checks the direction of the lead as set by the gunner.																								
5	Commands END OF MISSION when target is destroyed or neutralized— New targets will be selected and taken under fire as outlined above.																										
	*Ammunition and fuze selection. Ammunition and fuze combinations are as follows: 1. Shell HEP-T is designed for, and is highly effective against tanks and armored vehicles. 2. Shell HE M1, Charge 7, and Shell HE M482, Charge 8, is ideally suited for antipersonnel fire and is also effective against tanks and vehicles. 3. Shell, white phosphorous, may be used to set stalled tanks and other vehicles afire and produce casualties. 4. Fuze delay may be used for ricochet effect. The point of impact is adjusted 10 to 30 meters in front of the target. If less than 50 percent of the burst ricochet, change to fuze quick. 5. Fuze time is the least desirable and should be used at ranges of 1,000 meters or greater. Areas effectively covered by air and ricochet bursts are similar.																										

Table IV. Duties in Preparing for Traveling

Sequence	Chief of section	Gunner	Assistant gunner	Number 1	Number 2	Number 3	Number 4	Number 5
1	Commands MARCH ORDER. Inspects the chamber to verify that the piece is not loaded. Supervises work of cannoneers during all activities.	Sets azimuth counter to 3,200 mils and and closes window. Sets correction counter to zero. Closes 90° prism. Presses elbow release lever and places eyepiece in the traveling position. Covers level vials. Places pitch and cross-level mechanism in the approximate center of movement. Replaces protective cover on telescope and mount.	Sets elevation counter and correction counters to zero. Releases elbow telescope latches, slides telescope slightly to the rear, turns telescope to the traveling position and secures the latches. Places quadrant in approximate center of movement. Covers level vials. Replaces protective cover on telescope and quadrant. Inspects the chamber and bore to see that they are clear. Closes the breech block after the chamber and bore has been checked by the chief of section.	Assisted by number 3, recovers, disassembles, and stows the reference collimator (aiming posts if required). Disassembles and secures the rammer staff.	Replaces fuze setters and tools in the section chest, or howitzer stowage compartment as required. Assist numbers 4 and 5 by shifting the trail as directed when removing the stakes from the firing platform.	Assists number 1 to March Order reference collimator.	Assists number 5 to remove stakes-----	Assisted by number 4, removes stakes from the firing platform.
2				After the stakes have been removed from the firing platform, assisted by number 2, raises firing platform to the travel position.	Assists number 1 to raise the firing platform.	Connects and secures gun travel lock. Secures buffer travel lock.	Connects right suspension lock-----	Connects left suspension lock.
3	Directs prime mover into the howitzer position. Commands COUPLE.	Latches the pintle, and secures safety chains. Connects howitzer light system to prime mover.	Places tail light and muzzle cover assembly on the howitzer.	Connects terra tire travel lock----- Grasp left and right lifting handles respectively, raise the trail, and place lunette in the prime mover pintle.	Removes lunette pin, rotates lunette 180° to the travel position, and replaces locking pin.	Repack fuzes and ammunition as directed by the chief of section----- Under direct supervision of the chief of section, replaces powder increments in cartridge cases. Insure that all increments are present, in proper order, of proper log number and in good condition.		Repack fuzes and ammunition as directed by the chief of section. Retrieves and secures communications equipment.
4	Assisted by the gunner verifies that the section is prepared for travel. Commands MOUNT.	Assists the chief of section in supervising the March Order. Mounts in prime mover.	Takes post----- Mounts in prime mover-----	Takes post----- Mounts in prime mover-----	Takes post----- Mounts in prime mover-----	Takes post----- Mounts in prime mover-----	Takes post----- Mounts in prime mover-----	Takes post. Mounts in prime mover.
5	Reports to executive "Number () in order," or reports any defect the section cannot remedy without delay.							

Table V. Trajectory Characteristics

Cartridge HE, M1, Charge 7		Cartridge HEP-T		Cartridge HE, M482, Charge 8		Trajectory characteristics	Firing data
Range (meters)	Eleva- tion	Range (meters)	Eleva- tion	Range (meters)	Eleva- tion		
100	2	100	1	100	1	Within these ranges, the trajectory is flat enough to prevent an 8-foot tank from passing under it. A range of 500 meters is ideal for opening fire because fires can be conducted for the maximum time without misses if deflection is correct.	Start firing using 500 meter range setting.
200	4	200	3	200	2		
300	6	300	4	300	3		
400	8	400	6	400	4		
500	11	500	8	500	6		
		600	9	600	7		
		700	11	700	8		
				800	9		
				900	10		
600	13	800	13	1,000	12	Within these ranges, the trajectory is sufficiently flat to permit direct estimate of range without bracketing the target. If a hit is obtained at the bottom of an 8-foot tank, the addition of a 100 meter range change will result in a round that will just brush the top of the tank. Range changes will seldom be more than 100 meters, and 50 meter range changes will frequently be sufficient. These are the maximum ranges at which a tank should be fired on unless tactical conditions require otherwise.	1. Start firing with the estimated range to the closest 100 meter range. 2. Make range changes in 50- or 100-meter increments. 3. Bracket adjustment of the target (overs and shorts) is not required.
700	15	900	15	1,100	13		
800	18	1,000	17	1,200	14		
900	20	1,100	19	1,300	15		
1,000	22	1,200	21	1,400	17		
1,100	25	1,300	23	1,500	18		
				1,600	19		
				1,700	21		
				1,800	22		
				1,900	24		
1,200 to 1,800		1,400 to 2,000		2,000 to 2,500		Within these ranges hits are only reasonably possible. Bracket adjustment of the target is normally required.	1. Start firing with the estimated range at the closest 100-meter range. 2. Adjustment on the target (overs and shorts) is required. 3. Surprise effect on the target must not be important.
over 1,800		over 2,000		over 2,500		Direct laying at moving targets is not advisable. At these ranges the slope of fall of the projectile is such that a hit on a moving target is very difficult to obtain.	